

Contributions
of the
American Entomological Institute

Volume 5, Number 7, 1970



CONTRIBUTIONS TO THE MOSQUITO FAUNA OF
SOUTHEAST ASIA. - VI

The genus *Heizmannia* Ludlow in Southeast Asia

by

P. F. Mattingly

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CONTRIBUTIONS TO THE MOSQUITO FAUNA OF SOUTHEAST ASIA. - VI.

THE GENUS *HEIZMANNIA* LUDLOW IN SOUTHEAST ASIA¹

By

P. F. Mattingly²

INTRODUCTION

The Indomalayan species of the present genus were revised by Mattingly (1957) and the Thailand species by Thurman (1959). Since then a large amount of new material has come to hand, collected mainly by the staff of the SEATO Laboratory in Bangkok and the Institute for Medical Research in Kuala Lumpur. Besides new species this material includes a number of previously unknown males and early stages. Generic characters have accordingly required some modification, particularly those affecting the early stages which are now very much better known. Lien (1968) has described three new species from Taiwan. One of these, together with *Heizmannia achaetae* and a new species from Thailand, is placed in *Mattinglyia* Lien which is downgraded to a subgenus of *Heizmannia*.

The present paper deals with 19 species from Assam, Burma, Thailand, the Andaman Islands, Malaya, Borneo, Indonesia, Vietnam, the Philippines and Taiwan. Five of these species are new. Others are recorded for the first time from particular territories. *H. stonei* is relegated to the synonymy of *complex* and *metallica* to the synonymy of *indica*. The Indian species previously described as *metallica* will now require to be redescribed under a new name. *H. funerea* is removed from the synonymy of *scintillans* and the male is described for the first time. One or more of the new species described here was previously recorded as *greenii*. The latter appears to be confined to southern India and Ceylon.

The interesting phenomenon of mouthpart dimorphism (Mattingly, 1957) recorded by Lien (1968) for *macdonaldi* (as *nivirostris* Lien), *reidi* (as *cheni* Lien) and *taiwanensis* is here recorded for *communis*, *reidi* and

¹This work was supported by Research Contract No. DA-49-193-MD-2672 from the U. S. Army Medical Research and Development Command, Office of the Surgeon General.

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scintillans. It is not known whether the modification of the mouthbrush hairs to give the fine, filter-feeding or pectinate browsing type is wholly environmental, as in *Opifex* (Marks 1958, McGregor 1963), or has become genetically fixed.

The terminology and general treatment are those adopted by Bram (1967) with subsequent modifications by SEAMP. The spelling of Thai locality names is taken from the Official Standard Names Gazetteer #97 prepared by the Office of Geography, Department of the Interior, Washington, D. C., April 1966. Where names are known to represent administrative subdivisions e.g. Changwats, they are italicized. Those locality names which do not occur in the Gazetteer are spelled according to the labels on the specimens.

GENUS *HEIZMANNIA* LUDLOW

Heizmannia Ludlow 1905, Canad. Ent., 37:130. Type species: *Heizmannia scintillans* Ludlow. Monobasic.

Bolbodeomyia Theobald 1910, Rec. Indian Mus., 4: 31. Type species: *Bolbodeomyia complex* Theobald. Monobasic.

Mattinglyia Lien 1968, Trop. Med., Nagasaki, 10: 128. Type species: *Mattinglyia catesi* Lien.

Resembles the New World genus *Haemagogus*, differing chiefly in male secondary sexual characters. Features recalling the Sabethini include the possession by many species of broad iridescent scutal scales and, in the typical subgenus, a small patch of setulae on the postnotum. The males have short palpi and, in the typical subgenus, very lightly plumose antennae, again recalling the Sabethini. The early stages closely resemble those of *Aedes*. The larvae of a number of species have a very distinctive seta C-6, with two very unequal branches, of a kind found elsewhere only in *Aedes* subgenus *Christophersiomyia*. Lien (1968) recently erected a new genus, *Mattinglyia*, for *achaetae* (Leicester) and the closely related *catesi* Lien from Taiwan. However, *thelmae* n. sp. from Thailand, shares major characters of both groups. *Mattinglyia* is accordingly treated here as a subgenus of *Heizmannia*.

Generic characters are as follows:

FEMALE. Small, dark legged species with broad scaled scutum, frequently showing iridescent colors. Abdominal terga with conspicuous white or silvery triangular basal lateral markings. *Head.* Eyes well separated; tori with very small, fine hairs and, sometimes, scales on inner surface, appearing bare except under high magnification; clypeus bare except, sometimes, in *complex*; vertex with broad, flat, dark scales, small patches of broad white or silvery scales at the sides and between the eyes and a few very inconspicuous upright scales low down on occiput; proboscis variable, long and slender in some species, shorter and stouter in others; palpus

short, at most one-fifth of the length of the proboscis; basal joint of antennal flagellum with small, flat scales; flagellar segments subequal. *Thorax*. Scutum with dense covering of broad or moderately broad, flat scales with dull bronze, matt gold or bright metallic reflections; acrostichal and dorso-central bristles absent; prescutellars usually absent, at most 1-2; scutellum with broad, flat scales on all lobes; anterior pronotal lobes unusually large, almost contiguous in most species; posterior pronotum with broad, flat scales and with about 2-4 bristles in upper posterior corner; postspiracular bristles absent in most species; 1-2 lower mesepimeral bristles present; paratergite with flat, white or silvery scales; similar scales on postspiracular and subspiracular areas and on sternopleuron and mesepimeron; base of meron level with, or very slightly above base of hind coxa; postnotum with a group of small bristles posteriorly, except in *Mattinglyia*, occasionally mixed with a few broad scales in some species. *Legs*. Dark except for the femora; fore and mid femora pale below towards base; hind femur pale on basal three-fifths or more with dark dorsal stripe usually reaching to base; fore and mid claws usually simple; hind claws simple in all species. *Wing*. Dark scaled; alula with broad, flat, decumbent scales; squama with narrow, hair-like scales. *Abdomen*. Tergum I usually all dark; laterotergite white scaled; terga II-VI with conspicuous pale basal lateral markings; some species with pale basal bands or median spots on some or all of these terga, but with these marks varying even within the same species; some or all sterna with dark apical bands. *Terminalia*. Cerci broad or moderately broad; post-genital plate with concave or convex margin according to species; IXth tergum with 2 separate plates (fused in *Mattinglyia*); VIIIth sternum with posterior edge concave, strongly sclerotized and setose; spermatheca triple.

MALE. Resembling the female in general features. *Head*. Antenna (Figure 1) subplumose (plumose in *Mattinglyia*); the 2 terminal joints greatly elongated except in *complex* (a single specimen of *reidi* with male terminalia and with antenna of female type is, perhaps, a gynandromorph); palpus short as in female. *Legs*. One fore tarsal claw toothed, the other simple in most species, but both claws toothed in some; mid tarsal claws usually both simple but one or both toothed in some species. *Terminalia*. Swollen, conspicuous; distimere with terminal appendage directed at right angles to the main axis; inner face of basimere with 1-2 setigerous lobes (claspettes), the more distal one, as seen in the undisturbed position relative to the base of the basimere, often with an arm equipped with a falciform or irregularly shaped appendage (harpago in the original sense of Howard, Dyar & Knab, 1912, p. 69, Fig. 4), the proximal one often with conspicuous tufts of large, variously modified setae; inner aspect of sclerotized portion of basimere drawn out into a sub-apical lobe with 1-2 stout spines (partly modified to form leaflets in *Mattinglyia*); aedeagus with toothed lateral plates; apex of basimere with 1-2 rows of modified setae; paraprocts elongated, apically attenuated; IXth tergum concave with lightly setose lobes.

PUPA. *Cephalothorax*. Trumpets short, with meatus occupying at least two-thirds of the length, usually more; the apex expanded in the antero-posterior plane so that they appear conical in side view, cylindrical when

viewed from in front or behind; seta 1-I well developed, dendritic; 1-II moderately developed with 2-4 branches, sometimes more; seta 5-III-VI normally single; seta 9-II-VI minute, very inconspicuous, except in *aureochaeta* and *complex*; 9-VII-VIII stout, plumose. *Paddle*. Oval, usually narrow, with conspicuous, dark mid-rib and delicate fringe on both borders; seta 1-P long, single, sometimes frayed or split.

LARVA. *Head*. Broader than long; antenna short and straight in some species, longer and curved in others, tending to be dimorphic in those species with dimorphic mouthbrushes; seta 1-A small, with few or no branches; mouthbrushes with or without pectinate setae, dimorphic in this respect in several species; setae 4-C and 7-C multibranched, conspicuous; 5-C with number of branches very variable; 6-C usually anterior to 4-C, with 2 very unequal branches in a number of species, of normal type in others; mentum with 7-11 teeth on either side of central tooth. *Thorax and Abdomen*. Spines at bases of pleural setae variously developed; stellate setae absent; integument of thorax and abdomen without spicules; comb with not more than about 20 scales or spines (except in *reidi*); siphon without acus, usually about 2.5 - 4.0 times the length of the saddle but sometimes longer (up to nearly 5 times in some *macdonaldi*); pecten composed of spines, with or without small basal denticles, at most about 15 in number, usually much less; seta 1-S long, slender, usually bifid (except in *aureochaeta*, in which it is trifid or tetrafid), arising at most slightly beyond half way, usually before half way; saddle incomplete; seta 2-X with 2-4 branches, rarely 5; 3-X single, occasionally bifid; ventral brush with barred area present, usually well developed; seta 4-X single or bifid, rarely trifid (except in *reidi* and *achaetae*); 1-2 small precratal setae usually present; anal papillae large, cylindrical, bluntly rounded or pointed at tip, showing considerable individual variation.

DISTRIBUTION. Western Himalayas, Southwest India and Ceylon to Moluccas, Philippines, Taiwan and Korea. Found up to 7000 feet in the Himalayas.

BIOLOGY. Adults bite man freely, particularly in lowland forest and, as with *Haemagogus*, are often more numerous than would be expected from the number of detectable breeding places. Biting activity is most intense during the hottest part of the day. Breeding places include tree holes and split or bored bamboos and, in the case of *covelli*, other containers, such as split coconuts. Larvae are occasionally found in small ground pools, perhaps not always in consequence of washing out from other breeding places. For notes on biology see Macdonald & Traub (1960).

KEYS TO SOUTHEAST ASIAN SPECIES

FEMALES

1. Postnotum bare (Subgenus <i>MATTINGLYIA</i>).....	16
Postnotum with setulae (Subgenus <i>HEIZMANNIA</i>)	2
2(1). Scutal scales narrow with matt gold reflection.....	<i>demeilloni</i> n. sp.
Scutal scales broad with dull bronze or bright iridescent reflection	3

- 3(2). Scutal scales with dull bronze reflection; posterior pronotum
 wholly or mainly pale scaled 4
 Scutal scales with bright metallic reflection or posterior
 pronotum wholly dark scaled or both 8
- 4(3). Plume scales on vein R_2 narrow; postnotum often with
 scales as well as setulae 5
 Plume scales on vein R_2 broad or very broad; postnotum
 rarely with scales 7
- 5(4). Hind femur with dark ventral stripe reaching from apex to
 base *taiwanensis*
 Hind femur entirely pale below unless narrowly dark at tip 6
- 6(5). Proboscis entirely dark; cerci short and square *chengi*
 Proboscis usually with pale spot or streak below at base;
 cerci longer *complex*
- 7(4). Anterior pronotal lobes wholly or largely pale scaled ... *macdonaldi*
 These lobes pale scaled on anterior border only *aureochaeta*
- 8(3). Scutal scales with dull bronze reflection; anterior pro-
 notal lobes wholly or largely pale scaled *communis*
 Scutal scales with bright, iridescent, metallic reflection;
 anterior pronotal lobes various 9
- 9(8). Posterior pronotum entirely dark scaled 10
 Posterior pronotum wholly or largely pale scaled 15
- 10(9). Lateral lobes of scutellum with pale scales *mattinglyi*
 Lateral lobes of scutellum entirely dark 11
- 11(10). Proboscis at least 0.2 as long again as fore femur; cell
 R_2 at least 2.7 times as long as its stem, often longer *reidi*
 Without this combination of characters 12
- 12(11). Hind femur with dark apical band prolonged ventrally,
 as well as dorsally, towards base on anterior surface 13
 Hind femur pale below, except at tip, and anterior
 surface *covelli*
- 13(12). Basal lateral pale patches on abdominal terga prolonged
 inwards, tapering towards mid line 14
 These patches squarer, truncated *indica*
- 14(13). Anterior pronotal lobes almost entirely dark *funerea*
 Anterior pronotal lobes with pale scales extending at
 least some way round anterior border *scintillans*
- 15(9). A spot of broad, whitish scales present at edge of
 scutum above paratergite *persimilis* n. sp.
 Scales in this position all dark *propinqua* n. sp.

- 16(1). Anterior pronotal lobes entirely dark scaled *thelmae* n. sp.
 Anterior pronotal lobes entirely white scaled 17
- 17(16). Proboscis about 1.3 times length of fore femur; posterior
 pronotum with a few white scales only; wing scales
 narrow; lower mesepimeral bristle absent *catesi*
 Proboscis barely exceeding length of fore femur; posterior
 pronotum covered with silvery scales; wing scales broad;
 lower mesepimeral bristle present *achaetae*

The females of *proxima* n. sp. and *scanloni* n. sp. are unknown.

MALES

1. Antenna strongly plumose; postnotum without setae; basimere without subapical lobe (Subgenus *MATTINGLYIA*) 16
 Antenna very lightly plumose; postnotum with a tuft of
 setae; basimere with well developed subapical lobe
 (Subgenus *HEIZMANNIA*) 2
- 2(1). Subapical lobe with 2 spines 3
 Subapical lobe with 1 spine only 8
- 3(2). Scales of apical tuft, in part, with racket-shaped tips;
 appendage of distal claspette bluntly rounded;
 sclerotized *scanloni* n. sp.
 Apical tuft and distal claspette otherwise 4
- 4(3). Last 2 mid tarsomeres with conspicuous scale tufts *funerea*
 Mid tarsi without such tufts 5
- 5(4). Distimere with greatly enlarged crest; one group
 of long setae on proximal claspette fused at base
 to form a continuous sheet *chengi*
 Distimere and ornamentation of proximal claspette
 otherwise 6
- 6(5). Appendage of harpago slender, sickle-shaped; apex
 of basimere with row of 6 flattened, twisted
 setae *taiwanensis*
 Appendage of harpago broad, crumpled; setae at
 apex of basimere only slightly flattened 7
- 7(6). Paraprocts relatively broad *communis*
 Paraprocts much narrower *macdonaldi*
- 8(2). Distimere deeply cleft, with well developed hair tufts 9
 Distimere otherwise 10

- 9(8). Apical tuft with narrow scales only; antennal flagellum
with all segments subequal, as in female *complex*
Apical tuft, in part, with very broad scales; antennal
flagellum with the 2 terminal segments greatly
elongated *aureochaeta*
- 10(8). Proximal claspette with expanded, fimbriated
appendage *indica*
Proximal claspette without such appendage 11
- 11(10). Proximal claspette with a fan-shaped array of sinuous
filaments almost as long as basimere and distimere
combined *covelli*
Proximal claspette otherwise 12
- 12(11). Distal claspette with a slender, sickle-shaped
appendage *reidi*
Distal claspette without such appendage 13
- 13(12). Hind tarsus with a row of erect and suberect scales;
apical tuft with broad scales; distimere complex;
proximal claspette with dense tuft of long, sinuous
setae; distal claspette with 2 tufts of long setae *scintillans*
Hind tarsus without such scales; scales of apical tuft
narrower; distimere relatively simple; long setae
of proximal claspette much less numerous; distal
claspette without long setae 14
- 14(13). Apex of basimere with 2 widely spaced rows of flattened
setae; distimere with convoluted edge *propinqua* n. sp.
Apex of basimere with a single row of flattened setae
only; distimere with smooth, non-convoluted edge 15
- 15(14). Proximal claspette with several dark, sinuous setae
and with all setae of only moderate length *proxima* n. sp.
Proximal claspette without conspicuous, dark setae,
with a tuft of very long, sinuous setae *persimilis* n. sp.
- 16(1). Posterior pronotum covered with silvery scales;
apex of basimere with 2 apically expanded leaflets
and a patch of flattened, fimbriated setae *achaetae*
Posterior pronotum with a few white scales only;
apex of basimere with 2 relatively narrow leaf-
lets and a patch of hairs *catesi*

The males of *demeilloni* n. sp., *mattinglyi* and *thelmae* n. sp. are unknown.

PUPAE

1. Seta 5 on segment V of abdomen much less than half
as long as segment VI 2
This seta at least three-fifths as long as segment VI 3
- 2(1). Seta 5 on segment IV very short; seta 9 on segments
III-VI a short but conspicuous dark spine *aureochaeta*
Seta 5 on segment IV much longer; seta 9 on III-VI
minute, almost invisible under low power *achaetae*
- 3(1). Seta 5 on segment VI normally at least 1.2 times the
length of the following segment; paddle fringe very
long and coarse *reidi*
Without this combination of characters 4
- 4(3). Seta 9 on segments II-VI a conspicuous dark spine;
seta 5 on II long, stout and dark, resembling 2
and 3 on same segment *complex*
Without this combination of characters 5
- 5(4). Seta 1 on segment II with abundant secondary branching;
seta 6 on cephalothorax less than half as long as
seta 7 6
Without this combination of characters 7
- 6(5). Paddle generally narrower; 1.6 - 2.0 times as long
as broad *macdonaldi*
Paddle broader; 1.5 - 1.9 times as long as broad *communis*
- 7(5). Seta 5 on segment VI at most two-thirds as long as
segment VII 8
This seta normally at least three-fourths as long as
segment VII 11
- 8(7). Seta 9 on segment II-VI relatively long, dark,
conspicuous *chengi*
This seta minute, colourless, very inconspicuous 9
- 9(8). Seta 5 on segment IV almost as long as or longer
than segment V 10
This seta much shorter than segment V *thelmae* n. sp.
- 10(9). Paddle long and narrow, at least twice as long as
its greatest breadth *proxima* n. sp.
Paddle shorter, at most about 1.8 times as long
as its greatest breadth 12

- 11(7). Male genital sac with narrow apical horns *persimilis* n. sp.
? *propinqua* n. sp.
Male genital sac usually with apices bluntly
rounded *scintillans*
- 12(10). Paddle fringe unusually short and scanty; known
only from Burma and Thailand *demeilloni* n. sp.
Paddle fringe not unusually short and scanty;
known only from Taiwan 13
- 13(12). Paddle oval, pointed apically *taiwanensis*
Paddle pear-shaped with apex flattened *catesi*
- The pupae of *covelli*, *indica*, *mattinglyi*, *funerea* and *scanloni* n. sp. are
unknown.

FOURTH STAGE LARVAE

1. Setae of ventral brush with numerous branches;
comb of at least 30 scales with uniformly
fringed apex *reidi*
Without this combination of characters 2
- 2(1). All or most setae of ventral brush with at least 3
branches; pecten teeth minute *achaetae*
..... *catesi*
Without this combination of characters 3
- 3(2). All comb teeth with uniform apical fringe 4
Comb teeth, at least in part, with hypertrophied
median denticle 5
- 4(3). Antenna smooth; seta 1-A single or bifid; pecten
teeth stouter, the distal ones, at least, without
secondary denticles *complex*
Antenna spiculate; seta 1-A with 2-4 branches; distal
pecten teeth with conspicuous secondary denticles 13
- 5(3). Comb consisting entirely of spines with hypertrophied
median denticle 6
Comb of mixed spines and uniformly fringed scales 9
- 6(5). Comb spines with median denticle very short; antenna
short and straight *aureochaeta*
Without this combination of characters 7

- | | | |
|---------|--|--------------------------------------|
| 7(6). | Spines of bases of pleural setae very small | 9 |
| | These spines large, conspicuous | <i>proxima</i> n. sp. |
| 8(7). | Antenna long, curved; pecten well developed | <i>demeilloni</i> n. sp. |
| | Antenna short, straight; pecten teeth few, small | <i>thelmae</i> n. sp. |
| 9(5). | Head seta 6-C usually with 2 or more approximately
equal branches | 10 |
| | This seta single or with 2 very unequal branches | 11 |
| 10(9). | Head seta 6-C usually with 3 or more branches;
siphon at least 4.5 times as long as its breadth
at base | <i>macdonaldi</i> |
| | This seta normally bifid, rarely trifid; siphon
often shorter than this | <i>communis</i> |
| 11(9). | All comb teeth with median denticle at most very
feebly developed; most pecten teeth with con-
spicuous secondary denticles; mouthbrushes with
pectinate setae (? always) | <i>propinqua</i> n. sp. |
| | Without this combination of characters | 12 |
| 12(11). | Pecten teeth usually smooth or almost so, at most
1-2 of the more distal teeth with conspicuous
denticles | <i>scintillans</i>
<i>funerea</i> |
| | At least 3 teeth with conspicuous denticles | <i>persimilis</i> |
| 13(4). | Comb of 7-14 fringed scales of more or less
uniform size | ? <i>covelli</i> |
| | Comb scales more numerous | 14 |
| 14(13). | Comb with 2 groups of scales, the dorsal scales
much longer than the ventral; distal edge of
saddle with conspicuous spines | <i>chengi</i> |
| | Comb scales more or less equal in size; distal
edge of saddle with fine spicules only | <i>taiwanensis</i> |

The larvae of *indica*, *mattinglyi* and *scanloni* n. sp. are unknown.

SUBGENUS *HEIZMANNIA* LUDLOW

Heizmannia Ludlow 1905, Canad. Ent., 37: 130. Type species: *Heizmannia scintillans* Ludlow. Monobasic.

Bolbodeomyia Theobald 1910, Rec. Indian Mus., 4: 31. Type species: *Bolbodeomyia complex* Theobald. Monobasic.

Characterized by the presence of postnotal setae, simple fore and mid tarsal claws of females of most species, subplumose male antennae and well developed subapical lobe of male basimere bearing 1 or 2 stout spines.

HEIZMANNIA (HEIZMANNIA) AUREOCHAETA (LEICESTER)
(Figs. 2, ♀; 3, ♂ ♀ terminalia, ♂ claws; 4, pupa, larva)

Dendromyia aureochaeta Leicester 1908, Cul. Malaya, 255 (♀).

Resembles *complex*, *macdonaldi* and *communis*, and differs from other species, in the subdued, bronzy reflections from the scutal scaling. Differs from these 3 species in the characters given in the key. The male terminalia recall those of *complex*, from which, however, they differ in many details. The stout, unbranched seta 6-C of the larva also recalls *complex* but the comb and pecten teeth are very different in the 2 species. The pupa resembles that of *complex* in the well developed seta 9-III-VI and that of *achaetae* in the reduced seta 5-V. This is, however, a distinctive species in all stages, unlikely to be confused with any other. Principle characters are as follows.

FEMALE. *Head.* Top of head with broad, flat, dark scales and with flat, creamy scales at sides below, the latter not visible from above; a narrow border of small, flat, white scales round the eye margins, sometimes reaching to mid line; a triangular or diamond-shaped patch of snow-white scales between the eyes which are widely separated; basal joint of antennal flagellum with small, white scales on inner edge; proboscis short and relatively stout, about nine-tenths of the length of the front femur or slightly less; clypeus bare; palpus about one-seventh to one-fifth of the length of the proboscis. *Thorax.* Scutal scales with dull greenish bronze reflections; a few pale scales sometimes present immediately in front of mid lobe of scutellum and at apex of scutum; prescutellar bristles absent; scutellum dark except for a few broad, pale scales at apex of mid lobe in unrubbed specimens; upper surface of anterior pronotum dark except along the anterior border; posterior pronotum with broad, pale scales and with some broad, dark ones in upper posterior corner;

pleuron as described for *achaetae* except that the scales mostly have a creamy tinge; postnotum with a conspicuous patch of pale, very narrow scales or scale-like bristles and occasionally 1 or 2 broad scales. *Wing*. Plume scales on veins R_2 and R_3 very broad; cell R_2 about 3.5 - 4.5 times as long as its stem. *Legs*. Hind femur pale anteriorly and posteriorly on about the basal three-quarters to four-fifths with a broad, dark dorsal stripe reaching to base; first hind tarsomere pale below; all tarsal claws simple. *Abdomen*. Tergum I dark; remaining terga dark above with basal lateral creamy white patches prolonged backwards, ventrally, nearly to the posterior border on II, III and VI and sometimes also on IV and V, occasionally with median basal pale spot on IV-VII. Sterna II and III wholly or largely pale, IV-VI broadly dark at apex, VII dark. *Terminalia*. Postgenital plate small, convex, evenly rounded; postatrial plates moderately to strongly sclerotized.

MALE. *Head*. Antenna with the 2 terminal segments elongated; rest of flagellum much as in female. *Legs*. Fore claws each with a large tooth near base; one mid claw with a large, the other with or without a small tooth near base. *Terminalia*. Distimere deeply cleft, with tufts of hair resembling that of *complex* but with a short arm arising from outer edge near base; apex of basimere with a row of flattened, striated leaf-like setae and 1-2 similar setae between this row and the apex; subapical lobe with a long, sinuous spine; claspette greatly reduced, the distal claspette (*dcl*) with short hairs only, without harpago, the proximal claspette (*pcl*) with a few long, sinuous hairs; paraprocts each with 2 short, thumb-like processes at apex; Xth sternum membranous, pilose at base; aedeagus without special features; IXth tergum with 2 shallow lobes, each with about 4 small bristles; IXth sternum sclerotized basally and around edges and with a medium sclerotized area bearing several short bristles.

PUPA. *Cephalothorax*. Seta 6-C shorter than 7-C, single; 7-C single to trifid. *Abdomen*. Seta 1-II small with 2-4 simple or lightly plumose branches; 5-II slender, very delicate, single; 9-II-VI small and slender, but less so than in most other species, easily visible under low power; 5-IV-VI very small, less than half the length of the following segment, single, occasionally split distally; 9-VII and 9-VIII both short, with 1-3 and 1-4 branches respectively. *Paddle*. Variable, often broader than usual for the genus, about 1.2 - 1.7 times as long as greatest breadth, with fringe formed by a double row of fine, hair-like spicules; seta 1-P usually single, sometimes bifid; male genital sac triangular, the apical horns only slightly differentiated from the remainder.

LARVA. *Head*. Antenna short, cylindrical, smooth or almost so; seta 1-A single or bifid, often lightly plumose; inner mouthbrush setae pectinate in all cases; seta 5-C with 3-8 branches, usually 5-7; 6-C single or bifid, when single often swollen just beyond base. *Abdomen*. Comb of 7-13 spines (*cs*) with short, stout median denticles and conspicuous basal fringe, in 1-2 rows; siphon about 2.3 - 3.0 times the length of the saddle (about 2.5 times its breadth at base); pecten of 3-8 small but stout spines (*pt*) which usually have 1 or more basal denticles but are occasionally simple; seta 1-S with 3-5 branches, equal to or shorter than diameter of siphon at point of attachment,

usually arising beyond the terminal pecten tooth but occasionally between this and the subterminal tooth; saddle with distal edge very lightly spiculate; seta 1-X long, stout, plumose, bifid; 2-X bifid; 3-X single; anal papillae bluntly rounded, between 1.5 and 2.0 times the length of the saddle; ventral brush with 8-10 setae, the 6 most distal bifid, the rest with 3-5 branches.

TYPE DATA. Lectotype female, on pin, in British Museum; type locality: Jungle 6 miles from Kuala Lumpur, WEST MALAYSIA.

DISTRIBUTION. Specimens examined: THAILAND, *Nakhon Si Thammarat*, Banna Nabon 4 females, Khao Nawua Banna 1 female, Khao Luang Banna 1 female; *Phrae*, Rong Kwang 1 female; *Loei*, Phukaoung 1 female, Pat Meeung Mountains 1 female; *Ranong*, Khao Chatri 2 whole larvae; *Tak*, Khao Salak Phra 1 female. CAMBODIA, Pichnil 2 females. WEST MALAYSIA, *Selangor*, Kuala Lumpur, Ulu Gombak, Ulu Langat and Pahang road 30 females, 11 males, 17 larval and pupal skins, unnamed localities 2 females. *Other Distribution*. Recorded by Causey (1937) from Bangkok, Bon Pin and Chiang Muang, THAILAND.

TAXONOMIC DISCUSSION. This is a very distinct species, unlikely to be confused with any other. It is, perhaps, most closely related to *complex*, which it resembles in the male terminalia. One specimen from Cambodia has very small median basal pale spots on terga III-VI.

BIOLOGY. Said to bite man in daytime, in dense shade only (Causey 1937). Adults have been taken on man in forest, bamboo forest and a rubber plantation. Larvae have been found in bored bamboos in Malaya (Macdonald & Traub 1960) and in a flood pool in a bamboo grove at 2900 ft. in Thailand.

HEIZMANNIA (HEIZMANNIA) CHENGI LIEN
(Figs. 5, ♂♀; 6, ♂♀ terminalia, ♂ claws; 7, pupa, larva)

Heizmannia chengi Lien 1968, Trop. Med., Nagasaki, 10: 137 (♂*, ♀*, P*, L*).

This species closely resembles *complex* in external features of the female. The male antenna and terminalia are entirely different, however, the latter showing an interesting resemblance to those of *covelli* in the ornamentation of the proximal claspette.

FEMALE. *Head*. Top of head with narrow pale line bordering eyes, triangular pale patch between eyes; eyes comparatively close together behind; basal joint of antennal flagellum with conspicuous pale scales on inner side; palpus and proboscis dark; proboscis about 1.0 - 1.1 times the length of fore femur; palpus about one-seventh the length of proboscis. *Thorax*. Scutal scales with dull bronze reflection; a narrow line of pale scales round anterior border; pale scales on paratergite and a few in front of wing root; a small spot of pale scales on mid lobe of scutellum; anterior pronotal lobes with a pale spot in anterolateral corner and a few inconspicuous pale scales on anterior margin; posterior pronotum with patch of well developed bristles and some broad, pale scales. *Wing*. Plume scales narrow; anterior fork cell about 2.5 times as long as its stem. *Legs*. Anterior surface of hind femur pale

below on about the basal nine-tenths with dark dorsal stripe reaching base; fore and mid tarsal claws simple. *Abdomen*. Laterotergite pale scaled; terga II and III with basal lateral pale patches prolonged ventrally to posterior border of segment; terga IV-VI with similar patches but these not reaching the posterior border of the segment. *Terminalia*. Cerci shorter and squarer and postgenital plate broader than in *complex*.

MALE. *Head*. Antenna with the two distal flagellomeres greatly elongated; verticillary hairs on all flagellomeres short and scanty. *Legs*. One fore tarsal claw simple, the other with a large, straight tooth near base; mid claws simple or one with a straight tooth arising near base (see under Taxonomic Discussion). *Terminalia*. Distimere with a rounded, transparent crest and a short arm arising from the base of this; apex of basimere with a row of 4 only slightly flattened setae; subapical lobe with 1 stout and 1 more slender, twisted spine; distal claspette with well formed harpago (*h*) with fal-ciform appendage; proximal claspette (*pcl*) with a bunch of long, sinuous, flattened setae fused at base to form a transparent, striated sheet; paraprocts each with a thumblike process and 2 small teeth at tip; IXth tergum with well separated lobes each with 4-6 fine hairs; IXth sternum lightly but extensively sclerotized with numerous scales and 1-2 small setulae near tip.

PUPA. *Cephalothorax*. Seta 6-C shorter than 7-C, single; 7-C single or bifid. *Abdomen*. Seta 1-II slender with 2-4 branches; 5-II short, single, somewhat stouter and darker than usual; 9-II-VI short but dark and relatively conspicuous; 5-III-V single; 5-IV and 5-V slightly shorter than the following segment; 5-VI very short, single or bifid; 9-VII single; 9-VIII single to trifid; male genital sac with apical horns well differentiated. *Paddle*. Fringe relatively short and delicate; seta 1-P single.

LARVA. *Head*. Antenna relatively long, slender, curved, lightly spiculate; seta 1-A bifid; inner mouthbrush setae delicate, nonpectinate; seta 5-C with 13-14 branches; 6-C bifid or trifid with 1 branch usually longer and stouter than the other(s). *Abdomen*. Comb with about 22-27 uniformly fringed scales (*cs*), the dorsal group much larger than the ventral; siphon about 4 times as long as the saddle (about 3.5 times its breadth at base); pecten with 6-11 teeth (*pt*), the proximal ones longer, simple, the distal ones shorter, simple or with a secondary denticle at base; seta 1-S long, single; saddle with distal edge strongly spiculate; seta 1-X single; 2-X bifid; 3-X single; anal papillae very long, bluntly rounded at tip; ventral brush with 6 long setae in barred area and 2 short precratal ones; 1-2 of the long setae and sometimes 1 or 2 of the short ones bifid, the others single.

TYPE DATA. Holotype male and allotype female, with associated larval and pupal skins, in Taiwan Provincial Malarial Research Institute, Taipei; type locality: Peiyuan, Tungho Township, *Taitung*, TAIWAN.

DISTRIBUTION. Specimens examined: TAIWAN 1 male, 2 female paratypes, with associated larval and pupal skins, from the type locality. THAILAND, *Chumphon*, Muang 1 male; *Khon Kaen*, Padong Larn 2 females, 1 set of male terminalia; *Nakhon Ratchasima*, Ban Wang Ta Khian 1 male with associated pupal skin.

TAXONOMIC DISCUSSION. Taiwan and Thailand specimens agree well except that the only Thailand male examined has both mid tarsal claws simple whereas the male from Taiwan has one of them toothed. Too little is known regarding the extent of variation in this character to assess its significance. On present evidence I would not feel justified in describing the Thailand form as a distinct species or even subspecies.

BIOLOGY. The type series was bred out from a tree stump, with *Orthopodomyia anopheloides* and *Tripterooides bambusa*, on a forested hill at an altitude of 260 m. The male from Nakhon Ratchasima was bred out from a tree hole. The male from Chumphon was caught in a light trap.

HEIZMANNIA (HEIZMANNIA) COMMUNIS (LEICESTER)
(Figs. 8, ♀; 9, ♂♀ terminalia, ♂ claws; 10, pupa, larva)

Dendromyia communis Leicester 1908, Cul. Malaya, 254 (♂, ♀).

This species and *macdonaldi* form a closely related species pair. There seem, however, to be constant differences in all stages. Relationships to other species are obscure.

FEMALE. *Head.* Top of head with broad, flat, dark scales and flat white scales at sides, not visible from above; no pale scales round eye margins; a large diamond-shaped patch of silvery white scales between eyes; eyes well separated; basal joint of antennal flagellum with small, wholly or partly dark scales; proboscis short and stout, about nine-tenths of the length of the fore femur; clypeus bare; palpus about one-fifth of the length of the proboscis. *Thorax.* Scutal scales with dull, bluish bronze reflection; prescutellar bristles absent; scutellar scales all dark; upper surface of anterior pronotal lobes covered with broad, white scales, sometimes with a few dark scales posteriorly; posterior pronotum with dark scales only; paratergite with dark scales and some white ones along lower edge; posterior edge of sternopleuron with a stout bristle and, usually, 1-2 fine hairs in addition; pleuron otherwise much as in *achaetae*; postnotum with a patch of bristles, mostly rather pale. *Wing.* Plume scales on veins R_2 and R_3 broad; cell R_2 about 3.5 times as long as its stem. *Legs.* Hind femur pale on about the basal three-fifths and, sometimes, obscurely so for some distance beyond this, with dark dorsal stripe reaching to base; all tarsal claws simple. *Abdomen.* Tergum I dark; terga II-VI dark above with basal lateral white patches prolonged backwards ventrally only on II and, sometimes, slightly on III; tergum VII all dark or with narrow, incomplete, basal white band; sterna with dark apical, and pale basal bands, the latter often more yellowish in color than the basal lateral tergal patches. *Terminalia.* Postgenital plate bilobed; otherwise much as in *aureochaeta*.

MALE. *Head.* Antenna much as in the 2 previous species; proboscis distinctly longer and more slender than in the female. *Legs.* One fore tarsal claw with a long, slender tooth arising from base; the other simple. Mid tarsal claws both simple. *Terminalia.* Distimere relatively simple, with large terminal appendage; apex of basimere with a double row of setae

which are slightly, but not very conspicuously, flattened; subapical lobe with 2 unequal spines; distal claspette with a harpago (*h*) with broad, densely pilose stem and expanded transparent, membranous appendage; proximal claspette (*pcl*) with a bunch of long, twisted setae and 2 groups of shorter, flattened setae; paraprocts very lightly sclerotized, elongated, broadened towards apex; IXth tergum with lobes lightly sclerotized, well separated, each with 3-7 fine hairs; IXth sternum smaller than usual, strongly sclerotized, with a row of about 4 small bristles at apex.

PUPA. *Cephalothorax*. Seta 6-C single (bifid on one side in one specimen), shorter than 7-C which has 1-4 branches. *Abdomen*. Seta 1-II conspicuous, semi-palmate with short stem and considerable secondary and tertiary branching; 5-II small, very slender, single; 9-II-VI small, delicate; 5-IV and 5-V from somewhat shorter than to somewhat longer than the following segment, single or bifid; 5-VI single, about one-third to three-fifths of the length of the following segment, occasionally split towards tip; 9-VII and 9-VIII single to trifid and trifid to pentafid respectively. *Paddle*. From about 1.5 to 1.9 times as long as its greatest breadth with double fringe of fine hairs; seta 1-P usually bifid, rarely single or trifid on one side; male genital sac with apical horns usually, but not always, well differentiated.

LARVA. *Head*. Antenna dimorphic, shorter in those larvae with pectinate mouthbrush setae, longer in those without, lightly spiculate both basad and distad of seta 1-A; this seta bifid to tetrafid, simple or lightly plumose; mouthbrushes dimorphic, either with simple hairs only or with the inner setae strongly pectinate; seta 5-C with 3-10 branches; 6-C usually bifid, occasionally trifid on one side. *Abdomen*. Comb a mixture of 14-28 scales (*cs*), with uniform apical fringe, and spines each with a hypertrophied median denticle; siphon about 3.1 - 5.0 times the length of the saddle (about 3.0 - 7.0 times its breadth at base); pecten of 4-14 spines (*pt*), all or most of them usually with well developed secondary denticles and expanded at base; seta 1-S with 2-4 branches, approximately equal in length to the breadth of the siphon at point of attachment, variable in position, often arising at a considerable distance beyond the terminal pecten tooth; saddle with apex spiculate; seta 1-X long, lightly plumose, single or bifid; 2-X with 2-4 branches; 3-X single; anal papillae broad, bluntly rounded at tip, the ventral pair somewhat smaller than the dorsal; ventral brush with about 8 setae which are mostly bifid (mostly trifid in one larva), 1 or 2 sometimes single, the 2 smaller proximal setae without barred sockets.

TYPE DATA. Holotype male and allotype female, on pins, in British Museum; type locality: The Gap, *Selangor*, WEST MALAYSIA.

DISTRIBUTION. Specimens examined: THAILAND, *Chanthaburi*, Chaung Khao 17 females, 2 males, 13 larval and pupal skins, 3 pupal skins, 22 whole larvae; *Phangnga*, Nam Tai 1 female, 1 male, 1 pupal skin, Tang Mai 2 males, 2 pupal skins; *Ranong*, Ban Chatri 8 females, 1 male, 5 larval skins, 9 pupal skins, 3 whole larvae. WEST MALAYSIA, *Selangor*, The Gap 3 females, 2 males; Fraser's Hill 1 female, Ulu Langat 3 females, Ulu Gombak 16 females, 11 males, 18 larval and pupal skins; *Pahang*, Raub 1 female; *Perak*, Cameron's Highlands, 2500 feet 1 female. Unnamed Malayan

localities 6 females. *Other Distribution.* Recorded by Brug & Bonne-Wepster (1947) from INDONESIA, *Sumatra* and by Borel (1930) from COCHIN CHINA (but see under *covelli*).

TAXONOMIC DISCUSSION. Adults of both sexes can be separated from those of *macdonaldi* by the ornamentation of the posterior pronotum. Individual larvae and pupae may present difficulties but almost all those seen by me have been readily separable on the characters given in the keys. The larval mouthbrush dimorphism has been discussed above (p. 16). Nearly all the Malaysian larvae of the present species seen by me have browsing mouth-brushes but in all except one of the Thailand larvae they are of the filter feeding type.

BIOLOGY. Recorded as attacking man in forest. Breeding places mainly bored bamboos with small or moderate sized holes (Macdonald & Traub 1960).

HEIZMANNIA (HEIZMANNIA) COMPLEX (THEOBALD)
(Figs. 11, ♀; 12, ♂♀ terminalia, ♂ claws; 13, pupa, larva)

Bolbodeomyia complex Theobald 1910, Rec. Indian Mus. 4: 31 (♂, ♀).

Heizmannia stonei Mattingly 1957, Cul. Mosq. Indomalayan Area, 2: 51 (♀*).

NEW SYNONYMY.

Closely resembles *chengi* in external features but separable, in most cases at least, by the presence of a pale ventral spot or streak at the base of the proboscis. The female terminalia are also distinctive and the male terminalia are entirely different. Thailand specimens often have scales on the clypeus as well as on the postnotum. *H. complex* from Burma and Assam apparently lack these from both clypeus and postnotum. *H. stonei* was provisionally recognized as distinct by reason of the presence of these scales. However, the male terminalia proved to be identical with those of *complex*. I have therefore relegated it to the synonymy.

FEMALE. *Head.* Eyes with a more or less complete border of broad pale scales, closer together than in most other species; basal joint of antennal flagellum pale scaled; proboscis variable, from longer than to somewhat shorter than fore femur, with a pale spot or streak below at base; palpus about one-sixth the length of the proboscis or slightly less; clypeus bare or, in some Thailand specimens, with broad, flat, white scales. *Thorax.* Scutum covered with dark bronzy scales with subdued metallic reflection; broad pale scales usually present around anterior border, in front of wing roots and in front of mid lobe of scutellum; prescutellar bristles absent; mid lobe of scutellum with apical pale scales; pale scales also frequently present on lateral lobes; upper surface of anterior pronotal lobes pale scaled around whole of anterior border, dark behind; posterior pronotum entirely pale scaled; postspiracular area with 1-2 pale bristles; pleuron otherwise as described for the previous species; postnotum with a small patch of bristles and, frequently, some broad, pale scales in addition. *Wing.* Plume scales narrow

or very narrow; cell R_2 about 2.3 - 2.8 times the length of its stem. *Legs.* Hind femur pale on about the basal four-fifths to nine-tenths of the anterior surface with dark dorsal stripe reaching to base; all tarsal claws simple.

Abdomen. Terga I and II all dark or with median basal white spot; terga II to VII all dark above or one or more of these with a wholly or partly complete white basal band; all terga with basal lateral white patches which tend to be prolonged posteriorly at the outer edges; sternum II entirely pale; sternum III pale or with dark apical band; remaining sterna with dark apical bands.

Terminalia. Much as in *aureochaeta*; IXth tergum without setae (? always).

MALE. *Head.* Antenna with all joints subequal, as in female; verticillary hairs short and scanty. *Legs.* One fore tarsal claw simple, the other with a large tooth at base; mid tarsal claws both simple. *Terminalia.* Distimere deeply cleft with complex ornamentation, much as in *aureochaeta* but without the small arm near base; apex of basimere with a row of 5 flattened, striated setae; subapical lobe with a single slender, twisted spine; distal claspette (*dcl*) with a slender, very transparent arm, expanded at tip; proximal claspette represented by a small, well sclerotized lobe without bristles; paraprocts lightly sclerotized with thumb-like projection at apex; IXth tergum with lobes closely approximated, each with about 6-9 fine hairs; IXth sternum sclerotized at sides and with sclerotized median arm bearing a number of bristles.

PUPA. *Cephalothorax.* Seta 6-C long, stout and single (bifid on one side in one specimen), much longer and stouter than 7-C which is single or trifid. *Abdomen.* Seta 1-II with 2-5 branches (7 and 8 in the only Thailand specimen); 5-II long, stout, single (bifid on one side in one specimen), very conspicuous; 9-II-VI usually long and conspicuous; 9-VII single (sometimes split distally); 9-VIII single to trifid. *Paddle.* About 1.8 - 2.0 times its greatest breadth, with double fringe of fine hairs; seta 1-P slender, single; male genital sac with apical horns not very well differentiated.

LARVA. *Head.* Antenna short, straight, smooth; seta 1-A single or double; mouthbrushes with inner setae pectinate in all cases; seta 5-C single, usually expanded just beyond base, often markedly so; 6-C with 1-3 branches (4-8 in Thailand larvae). *Abdomen.* Comb of 8-18 dark, finely fringed scales (*cs*), the majority, usually, rather long and narrow; siphon about 4.0 - 5.5 times the length of the saddle (about 3.0 - 4.0 times its breadth at base; pecten of 1-5 (usually 3-4) spines (*pt*), all or most of them, usually, with secondary denticles minute or absent; seta 1-S bifid, arising well beyond the distal pecten tooth; saddle with apex strongly spiculate; seta 1-X long, lightly plumose, bifid or, rarely, trifid; 2-X with 2-3 branches, rarely 4; 3-X single; anal papillae broad, cylindrical, bluntly rounded at tip, the ventral pair slightly shorter than the dorsal; ventral brush with 8 setae, the 2 most anterior with 2-5 branches, the other with 2-3.

TYPE DATA. *H. complex* (Theobald), holotype male terminalia and wing, on slides, in the British Museum; remainder of this specimen, on pin, in Indian Museum; allotype female, on pin, in Indian Museum; type locality: Dawna Hills, LOWER BURMA. *H. stonei* Mattingly, type female, on pin, in British Museum; type locality: Ulu Langat, *Selangor*, WEST MALAYSIA.

DISTRIBUTION. Specimens examined: INDIA, *Assam*, Nongpoh 2 females; Haflong 1 female. BURMA, Dawna Hills 1 female, 1 male. THAILAND, *Chiang Mai*, Doi Suthep 1 female; *Nakhon Nayok*, Ka-Ang Waterfall 1 female, 2 whole larvae, 1 larval and 1 pupal skin, Sariga Village 1 female; *Nakhon Si Thammarat*, Khao Luang Banna 1 female; *Udon Thani*, Muang 5 females, Ban Kut Ling Hyou 1 female; *Chon Buri*, unnamed locality 2 females; *Phrae*, Rong Kwang 2 females; *Lamphun*, Kang Arb Nang 2 females; *Ubon*, Chong Mek 1 female. WEST MALAYSIA, *Selongor*, Ulu Gombak 19 females, 5 males, 15 larval and pupal skins, Ulu Langat 1 female, The Gap 3 females. VIETNAM, Cheo Reo 1 female, Cam Ranh 11 females. CAMBODIA, Kirirom 1 female, Pichnil 1 female. *Other Distribution*. Recorded from locality between Bon Pin and Chieng Molang (? = Bon Chiang Muang), THAILAND by Causey (1937). Recorded by Borel (1930) from Terres Rouges, COCHIN CHINA.

TAXONOMIC DISCUSSION. Specimens from Tad Muay Falls, Phrae Province, Thailand, provisionally recorded by Thurman (1959) as *stonei* are, in fact, *achaetae*. Her records of *complex* are here confirmed. Borel's description and figures of *complex* from Indochina differ in some small particulars from the above but it is significant that he described the male antenna as having all segments equal, a very unusual feature otherwise known to me only in the present species and in an aberrant male of *reidi* (p. 35). His drawing of the male terminalia, though rough, also agrees quite well with the present species as does his description of the rather characteristic larval comb scales. I am inclined, therefore, to accept his record, particularly as there are females agreeing well with this species, from Vietnam, in the U. S. National Museum.

BIOLOGY. Recorded as attacking man in forest. Causey (1937) records it as collected on a horse. Larvae have been found in tree holes in Malaya (Macdonald & Traub 1960) and in bamboos in Thailand.

HEIZMANNIA (HEIZMANNIA) COVELLI BARRAUD
(Figs. 14, ♂♀; 15, ♂♀ terminalia, ♂ claws; 16, larva)

Heizmannia covelli Barraud 1929, Indian J. med. Res. 17: 265 (♂*, ♀).

This species is known with certainty only from the adult male. Barraud (1929) described an allotype female, from Sukna, N. Bengal, which has apparently been lost. It is not, as stated by Barraud, in the British Museum and there is no record of its ever having been received there. A female from the Andaman Islands, identified as this species by Barraud, is in the British Museum and I formerly marked it, provisionally, as a paratype (Mattingly 1957). Having now had the opportunity to compare it with other material, I am inclined to doubt that it belongs to the present species. I have, therefore, omitted it from the following description and noted differences in the Taxonomic Discussion below. The following description of the female is based on material from Thailand, provisionally attributed on the basis of a comparison with males and with Barraud's description of the allotype.

FEMALE. *Head*. No pale scales round borders of eyes; eyes well separated; basal joint of antennal flagellum dark scaled; proboscis about nine-tenths the length of the fore femur; palpus about one-seventh to one-sixth the length of the proboscis; clypeus bare. *Thorax*. Scutal scales with bright gold reflection shot with red and blue; prescutellar bristles absent; scutellum with dark scales on all lobes (but see below under Taxonomic Discussion); upper surface of anterior pronotal lobes covered with silvery scales, narrowly dark behind; posterior pronotum entirely dark scaled; postspiracular bristles absent; postnotum with conspicuous tuft of bristles. *Wing*. Plume scales narrow except distally on R_2 and, to a less extent, R_3 ; cell R_2 about 2.5 times the length of its stem or slightly more or less. *Legs*. Hind femur pale on about the basal three-fourths to four-fifths of the anterior surface with dark dorsal stripe reaching to base. *Abdomen*. Tergum I dark; II-VI with basal lateral triangular white patches extending ventrolaterally to the posterior edge of the tergum on II and inwards well towards the mid line; II-V with or without median pale basal spots which may fuse with the basal lateral pale patches in some cases; VI and VII with or without a basal pale band; distal sterna dark apically; sternum II apparently all pale. *Terminalia*. Postgenital plate smooth or very slightly emarginate at tip; postatrial plates strongly sclerotized; sclerotized portion of spermathecal duct noticeable longer than usual (? always).

MALE. *Head*. Antenna with the 2 terminal joints of the flagellum greatly elongated. *Legs*. Each fore tarsal claw with a large tooth at base; one mid tarsal claw with a stout tooth, the other with a very slender, hair-like tooth at base. *Terminalia*. Distimere much as in *communis* but less expanded apically and with a more sharply marked median fold or ridge; apex of basimere with a double row of flattened, striated setae; subapical lobe with a stout, twisted spine and a slender seta immediately adjacent to it; distal claspette (*dcl*) with appendix of harpago reduced to a small lobe resembling a larval comb scale; proximal claspette (*pcl*) with 3 setose lobes, one with very long, sinuous, flattened setae, their bases fused to form a transparent, striated sheet; paraprocts with thumb-like appendage at tip; IXth tergum with rounded lobes, each with about 4 small setae; IXth sternum almost completely sclerotized with a median lobe bearing about 10 small setae.

PUPA. Not known.

LARVA. Provisionally described from unassociated whole larvae (see below under Taxonomic Discussion). *Head*. Antenna moderately long, curved, lightly spiculate; seta 1-A with 2-4 branches; mouthbrushes with fine, non-pectinate setae only; seta 5-C with 6-12 branches; 6-C single or with 2 very unequal branches. *Abdomen*. Comb of 7-14 narrow, more or less uniformly fringed scales (*cs*); siphon about 2.7 - 3.0 times the length of the saddle (3.5 - 4.0 times breadth at base); pecten of 4-8 large teeth (*pt*) mostly with conspicuous basal denticles, but some of the basal ones sometimes simple; seta 1-S with 2-3 branches, arising just beyond distal pecten tooth, longer than diameter of siphon at point of attachment; saddle with distal edge spiculate especially around bases of caudal setae; seta 1-X single or bifid; 2-X with 2-3 branches; 3-X single; anal papillae bluntly rounded, the dorsal pair longer than

the ventral; the dorsal pair about 3 times as long as the saddle in specimens from *Chiang Mai* (much shorter than this in specimens from Trad and Rangoon but these appear to be immature); ventral brush with 6 setae in the barred area and 1-2 smaller precratal setae; all these setae single or bifid except for the most proximal seta in the barred area which is trifid in one specimen.

TYPE DATA. Lectotype male on pin, with terminalia on celluloid mount, in British Museum; type locality: *Andaman Islands* (see Mattingly 1957). Allotype female believed lost; type locality: Sukna, *North Bengal*, INDIA.

DISTRIBUTION. Specimens examined: INDIA, *North Bengal*, Sukna 1 male. *Andaman Islands*, 2 males. BURMA, Rangoon 2 whole larvae. THAILAND, *Chiang Mai*, Doi Suthep 1 female, 1 male, Ban Pha Tak 1 female, Ban Kee Lek 1 female, Huey Chang Kien 1 female; *Trat*, Ko Chang 3 females, 1 whole larva; Unnamed localities 1 female, 2 whole larvae. *Other Distribution*. Recorded by Causey (1937) from locality between Bon Pin and Chieng Moeang (? = Ban Chiang Muang) THAILAND. A record of "*H. communis*" from COCHIN CHINA (Borel 1930) may also refer to the present species (see below).

TAXONOMIC DISCUSSION. Barraud (1929, 1934) mentions the presence of silvery scales at the apex of the mid lobe of the scutellum. No such scales are present in the Andaman specimens in the British Museum or in any of the specimens from Thailand. They may have been present in the missing allotype. No associated larval or pupal skins are available but some whole larvae from Thailand resemble those from Burma attributed by Barraud to the present species. No other Burmese material has been preserved but the presence of *covelli* in Thailand has been confirmed from male terminalia. The description of the female adult and, particularly, the larva of "*H. communis*", from Cochin China, by Borel (1930) would agree better with the present species. Females seem most likely to be confused with those of *scintillans* and, perhaps, *mattinglyi*. Thurman (1959) treats the color of the scutal scaling as diagnostic but this is based on a misinterpretation of Barraud's description, which is misleading. She does not appear to have seen any specimens.

BIOLOGY. Not clearly recorded as attacking man. Causey (1937) records it as biting by day in jungle but says it was collected from a horse. The whole larva described here came from tree holes and a coconut. The paratype male from the Andamans is labeled as from a bamboo stump and the Thailand male and the male from Sukna as from tree holes. Records by Jolly (1933) from a variety of artificial containers, as well as from tree holes and bamboos, in Rangoon require confirmation.

HEIZMANNIA (HEIZMANNIA) DEMEILLONI n. sp.

(Figs. 17, ♀; 18, ♀ terminalia, pupa, claws)

Closely related to *himalayensis* Edwards, of which it may be a subspecies. It is, however, distinguished from this, and all other species in the genus, by the striking scutal ornamentation. *H. himalayensis* has not been

recorded from Southeast Asia but it occurs in *North Bengal* and may well be found in East Pakistan. Some notes on this species will be found in the Taxonomic Discussion below.

FEMALE. *Head.* No continuous border of white scales round eye margins although the usual ventrolateral patches of white scales extend inwards, narrowly, well towards the median patch between the eyes; eyes widely separated as far forwards as the tori; basal joint of antennal flagellum with dark scales only; proboscis slender, about 1.1 times the length of the fore femur; palpus about one-tenth the length of the proboscis; clypeus bare. *Thorax.* Scutal scales narrower than in other species (except *himalayensis*) with bright, matt gold reflection, quite different from the brassy reflection seen in *covelli* and *scintillans* and with much less tendency to the formation of iridescent colors than in those species; prescutellar bristles absent; mid lobe of scutellum with broad silvery scales and some dark ones, lateral lobes dark scaled; upper surface of anterior pronotal lobes almost entirely covered with broad white scales; posterior pronotum with similar scales below; some dark scales above; postspiracular bristles absent; postnotum with pale colored bristles, without scales. *Wing.* Plume scales broad; cell R_2 variable but long in all cases, from about 3.0 - 4.5 times the length of its stem. *Legs.* Hind femur pale on basal four-fifths or more of anterior surface with dark dorsal stripe broadening towards tip; this stripe very narrow on basal half but reaching to base; all tarsal claws simple. *Abdomen.* Tergum I with a small pale spot; laterotergite pale scaled; terga II-IV dark above; V with inner edges of basal lateral pale spots visible on dorsal surface; VI and VII with basal pale bands; all terga with triangular basal lateral pale spots, prolonged along ventrolateral edge to posterior edge of terga II and III; sterna with dark apical bands (II apparently all pale). *Terminalia.* Postgenital plate square-ended but without apical emargination.

MALE. Not known.

PUPA. *Cephalothorax.* Seta 6-C longer than usual, not very much shorter than 7-C, single; seta 7-C somewhat longer, more slender, single or bifid. *Abdomen.* Seta 1-II (preserved in only one specimen) with 3-4 primary branches, little or no secondary branching; 5-II small and very delicate; 9-II-VI minute, very inconspicuous; 9-VII single; 9-VIII with 3-4 branches. *Paddle.* About 1.5 - 1.7 times as long as its greatest breadth; fringe of fine hairs shorter and scantier than in most species; seta 1-P broken.

LARVA. The slide preparation of the larval skin was lost before it could be illustrated. *Head.* Antenna long, curved, moderately stout, spiculate; seta 1-A bifid, arising unusually near tip; mouthbrushes with fine, non-pectinate hairs only; setae 5-C and 6-C not seen. *Abdomen.* Comb an irregular patch of 9-12 spines with fine basal fringe and strongly hypertrophied median denticle; siphon about 3 times the length of the saddle (about 3.5 times the breadth at base); pecten of 4-7 spines, all with strongly developed basal denticles; seta 1-S arising just beyond terminal pecten tooth, bifid, about equal in length to the breadth of the siphon at point of attachment; saddle with apex lightly spiculate; seta 1-X missing; 2-X with 4 branches; 3-X single; anal

papillae about 2 times as long as saddle, relatively narrow, cylindrical, bluntly pointed, the ventral pair slightly shorter than the dorsal; ventral brush apparently with 8 setae, all of them missing except 1 of the 2 precratal setae which is bifid with one branch split secondarily into 2.

TYPE DATA. Holotype female, on pin, with associated pupal skin on slide in U. S. National Museum; type locality: Kalaw, BURMA.

DISTRIBUTION. Specimens examined: BURMA, Kalaw 3 females, 1 larval and 3 pupal skins. THAILAND, *Chiang Mai*, Doi Suthep 1 female.

TAXONOMIC DISCUSSION. As noted above, *himalayensis* is closely related to the present species. It differs chiefly in the coloration of the scutal scaling which has a characteristic dark blue reflection. Other differences are as follows: proboscis slightly shorter, about equal in length to fore femur; cell R_2 about 2.5 - 3.5 times the length of its stem; plume scales narrower (but the specimen of *demeilloni* from Thailand has them narrower than in the Burmese specimens); hind femur with dark dorsal stripe not reaching base; white basal lateral patches on abdominal terga narrower, prolonged backwards, if at all, only on tergum II; pale basal median spots or bands sometimes present on II-V; postgenital plate slightly more rounded than in *demeilloni*; terminalia otherwise very similar. Early stages very similar except that the larva of *himalayensis* has a much shorter antenna.

BIOLOGY. The Burmese specimens were bred out from bamboo stumps.

HEIZMANNIA (HEIZMANNIA) FUNEREA (LEICESTER)

(Figs. 19, ♀; 20, ♂ ♀ terminalia, ♂ claws; 16, larva)

Wyeomyia funerea Leicester 1908, Cul. Malaya, 252 (♀).

Closely resembles *indica* and *scintillans*, differing in the greatly reduced pale scaling on the prothoracic lobes. The males are easily recognized by the plumose mid tarsi which are unique in the genus.

FEMALE. *Head*. Top of head dark with ventrolateral pale patches and small pale spot between the eyes; basal joint of antennal flagellum with pale scales, dark in some lights; proboscis about 1.1 times as long as fore femur; clypeus bare; palpus about one-fifth of the length of the proboscis.

Thorax. Scutal scales with green, purple and blue reflections; scutellum dark scaled; anterior pronotal lobes largely dark scaled with small pale spot on anterior border; posterior pronotum dark scaled; postspiracular bristles absent; postnotum with tuft of dark setulae. *Wing*. Plume scales mostly narrow, broader on veins R_2 and R_3 ; cell R_2 about 1.8 - 3.0 times as long as its stem. *Legs*. Hind femur with about the basal two-thirds to three-fourths of the anterior surface pale, the dark apical band prolonged ventrally to base.

Abdomen. Tergum I dark; laterotergite white scaled; terga II-VI dark above with triangular basal lateral pale patches prolonged inwards well towards mid line but not forming a complete basal band on any segment; basal lateral pale

spot on tergum II prolonged along the ventral border to the posterior edge of the tergum; the corresponding spot only slightly prolonged on other terga; distal sterna with dark apical bands; sternum II apparently entirely pale; sternum VII pale at base in some specimens, entirely dark in others. *Terminalia*. Postgenital plate expanded at apex.

MALE. *Head*. Antenna lightly plumose; the two terminal joints greatly elongated. *Legs*. Fourth and fifth mid tarsal segments with tufts of sub-erect scales; hind tarsus with the last two segments missing; other segments without any such scales; one fore and one mid tarsal claw with slender tooth at base. *Terminalia*. Much as in *scintillans* but with leaflike setae at apex of basimere somewhat broader, 2 spines on subapical lobe and distal claspette (*dcl*) quite different, more as in *persimilis*, *propinqua* and *proxima* n. spp.

PUPA. Not Known.

LARVA. *Head*. Antenna long, slender, lightly spiculate; seta 1-A with 4-5 branches, arising at or slightly before half way; mouthbrushes without pectinate setae; seta 5-C with about 10-15 branches; 6-C with 2 very unequal branches. *Abdomen*. Comb a patch of about 13-20 scales (*cs*), with uniform apical fringe, and spines with hypertrophied median denticle; siphon about 3 times the length of the saddle (about 3.5 times its breadth at base); pecten of 6-9 slender teeth (*pt*) without secondary denticles; seta 1-S missing from both the available specimens, its base situated just beyond the distal pecten tooth; saddle with apex lightly spiculate; seta 1-X long, single; 2-X bifid; 3-X single; anal papillae short, broad, bluntly rounded at tip, subequal; ventral brush with 6 setae in barred area, all single or bifid, and 2 precratal setae, both single.

TYPE DATA. Holotype female on pin in British Museum; type locality: Jungle 6 miles from Kuala Lumpur on Pahang Road, *Selangor*, WEST MALAYSIA.

DISTRIBUTION. WEST MALAYSIA, *Selangor*, 6th mile, Pahang Road 1 female, 10th mile, Banting Road 1 female, Ampang Forest Reserve 14 females, 1 male. EAST MALAYSIA, *Sabah*, Tawau 2 females. SINGAPORE 1 female, 2 unassociated larval skins, 4 immature whole larvae.

TAXONOMIC DISCUSSION. Though closely related to *scintillans* and formerly placed in the synonymy of that species (Mattingly 1957) it is clear from the secondary characters of the male, described here for the first time, that this is a distinct species. Two specimens from Singapore placed by Edwards under *funerea* included a male of *indica*. I therefore tentatively suggested that the larva described by Edwards and Given (1928) as *funerea* might, in fact, be that of *indica*. Comparing the other specimen from Singapore, a female, with the new material of *funerea* from Ampang, however, I am satisfied that it is the present species. It seems best, therefore, to accept Edwards and Given's identification provisionally and to treat the larva of *indica* as still unknown.

BIOLOGY. Edwards and Given's larvae came from a tree hole.

HEIZMANNIA (HEIZMANNIA) INDICA (THEOBALD)
(Figs. 21, ♀; 22, ♂♀ terminalia, ♂ claws)

Phoniomyia indica Theobald 1905, Ann. hist.-nat. Mus. hung. 3: 115 (♂*).
Wyeomyia metallica Leicester 1908, Cul. Malaya, 251 (♀). NEW SYNONYMY

Closely resembles *scintillans* and *funerea* but is distinguishable by the more uniformly blue color of the scutal scaling and the truncation of the basal lateral pale triangles on the abdominal terga. The advent of further material has strengthened the view that Leicester's '*H. indica*' was in fact *reidi* (Mattingly 1957). It has also made it possible to synonymize his *metallica* with the present species with some assurance. The Indian species attributed to *metallica* by Edwards (1922) and Barraud (1929, 1934) is evidently distinct. It will require to be redescribed under a new name. It differs markedly in the male terminalia and has decidedly narrower wing scales, especially on the veins of the upper fork.

FEMALE. *Head.* Eyes well separated; ventrolateral patches of pale scales on head extending in towards mid line but eye margins without continuous border of pale scales; basal joint of antennal flagellum with a small spot of pale scales and, usually, some dark ones; proboscis long and slender, about 1.2 times as long as front femur; palpus about one-fifth or less the length of the proboscis; clypeus bare. *Thorax.* Scutal scales mainly with dark blue and blue-green reflections; no prescutellar bristles; scutellar scales all dark; anterior pronotal lobes with pale scaling variable in extent but always limited to the anterior edge, dark scales posteriorly; posterior pronotum wholly dark scaled; postspiracular bristles absent; postnotum with a strongly developed group of dark bristles. *Wing.* Plume scales on R_2 and R_3 narrow to moderately broad; cell R_2 from less than 2 times to about 2.5 times as long as its stem. *Legs.* Hind femur pale on about the basal two-thirds to seven-tenths with broad, dark dorsal stripe continued to base and also with a dark ventral stripe, variously developed (much as in *scintillans*, Figure 39, p. 39). *Abdomen.* Terga I-VI dark above; VII sometimes with a narrow pale basal band or small basal lateral patches, sometimes all dark; II-VI with basal lateral white spots truncated, not extending far inwards or tapering to a point towards mid line, extending posteriorly along ventrolateral edge only on II and to some extent on III; sterna with broad dark apical bands. *Terminalia.* Cerci short and broad; postgenital plate bluntly rounded at apex.

MALE. *Head.* Antenna with the 2 terminal joints greatly elongated. *Legs.* One fore tarsal claw with a slender, straight tooth at base; the other simple; mid tarsal claws similar but the single tooth even more slender. *Terminalia.* Distimere resembling that of *covelli* but differing in various details; apex of basimere with a row of 6 short, narrow, striated setae; subapical lobe with a single large twisted spine; distal claspette (*dcl*) with 2 groups of stout setae, one group with hooked tips; no harpago; proximal claspette (*pcl*) with 2 groups of flattened setae, the longer group with fimbriated tips, and a broad appendage recalling the fused basal portions of the long setae in

chengi and *covelli* but with these setae reduced to short, blunt, transparent, faintly striated leaflets; paraprocts with thickened, doubly recurved tips; IXth tergum strongly sclerotized; each lobe with about 6-8 fine hairs; IXth sternum almost completely sclerotized, with a stout bristle near apex.

PUPA and LARVA. Not known.

TYPE DATA. *H. indica* (Theobald), holotype male on pin in Hungarian National Museum; type locality: SINGAPORE. *H. metallica* (Leicester), holotype female on pin in British Museum; type locality: Bukit Kutu, *Selangor*, WEST MALAYSIA.

DISTRIBUTION. Specimens examined: SINGAPORE 2 males. WEST MALAYSIA, *Selangor*, Bukit Kutu 1 female, Pahang Road 1 female, Ampang 1 female, Ulu Gombak 12 females, 1 male, Banting Road 1 female; *Perak*, Bt. Pulau Tiga 1 female; *Pahang*, Kuala Tahan 1 male, Kuantan 1 female. *Other Distribution*. The record by Causey (1937) from THAILAND ("between Bon Pin and Chieng Moeang") may refer to *reidi* (see p. 35).

TAXONOMIC DISCUSSION. Additional characters which may be of diagnostic value are the small size of the present species (wing length at most 2.5 mm. in specimens assignable with confidence), mainly bluish scutal scaling, all dark first hind tarsus and generally pale scutal integument. The larva at one time attributed provisionally to this species is now assigned to *funerea* (see p. 23). The early stages of the present species remain unknown. Records of "*H. indica*" from India (Barraud 1929, 1934, Edwards 1922), and some from Malaya (Leicester 1908) are considered to refer to *reidi* (see p. 35).

BIOLOGY. The holotype of *metallica* was taken in a house. Other adults have been taken on man in forest in daytime.

HEIZMANNIA (HEIZMANNIA) MACDONALDI MATTINGLY

(Figs. 23, ♀; 24, ♂ terminalia, claws; 25, pupa, larva)

Heizmannia macdonaldi Mattingly 1957, Cul. Mosq. Indomalay. Area 2: 47 (♂*, ♀*, P*, L*).

Heizmannia nivirostris Lien 1968, Trop. Med., Nagasaki, 10: 139 (♂*, ♀*, P*, L*). NEW SYNONYMY.

This species is very similar to *communis*, the 2 evidently constituting a closely related sibling species pair. The females differ constantly in the scaling of the posterior pronotum (dark in *communis*, pale in the present species) and there are small, but apparently constant, differences in the male terminalia. The larvae and pupae cannot be separated in every case but, on present evidence, the overlap is only slight.

FEMALE. *Head*. Top of head dark with lateroventral white spots and a large white spot between the eyes which are widely separated; eye margins largely, usually wholly, dark; basal joint of antennal flagellum with whitish or pale brown scales, appearing dark in some lights; proboscis approximately equal in length to fore femur, rather more thickened towards tip than

in most species, with a distinct pale line below towards base; palpus from one-fifth to one-fourth of the length of the proboscis; clypeus bare. *Thorax*. Scutal scales with subdued, dull bronze reflection; prescutellar bristles absent; scutellar scales all dark; anterior pronotal lobes wholly or largely pale scaled; posterior pronotal scales mostly whitish or pale brown; postspiracular bristles absent; postnotal bristles dark. *Wing*. Plume scales broad; cell R_2 about 3.0 - 3.5 times as long as its stem. *Legs*. Hind femur pale below on anterior surface for about the basal six-sevenths, more narrowly so towards tip. *Abdomen*. Tergum I dark; terga II-VI with basal lateral pale patches prolonged backwards along ventral border on II and to a variable extent, on III; V-VII dark above or, occasionally, with pale basal bands; sterna with dark apical bands. *Terminalia*. Postgenital plate emarginate at apex, very much as in *communis*.

MALE. *Head*. Antenna of normal type; proboscis much as in female. *Legs*. One fore tarsal claw with a long, slender tooth at base; the other simple. Mid tarsal claws both simple. *Terminalia*. Very like those of *communis*, differing mainly in the slender paraprocts and the narrower 'neck' at the base of the appendage of the harpago (*h*). Small differences in the ornamentation of the proximal claspette (*pcl*) do not seem to be constant.

PUPA. *Cephalothorax*. Seta 6-C single, shorter than 7-C which is single to tetrafid. *Abdomen*. Seta 1-II strongly developed, semi-palmate; 5-II short, very slender, single; 9-II-VI small, delicate; 5-IV and 5-V about equal in length to the following segment or somewhat longer or shorter; 5-VI about half as long as the following segment or less; 9-VII and 9-VIII single to tetrafid and single to pentafid respectively. *Paddle*. From about 1.6 - 2.0 times as long as its greatest breadth; seta 1-P single to trifid; male genital sac with apical horns poorly differentiated.

LARVA. *Head*. Antenna dimorphic, as in *communis*, shorter in those larvae with pectinate mouthbrush setae, longer in those with the filter-feeding type of mouthbrush, spiculate for most of its length; seta 1-A with 2-6 branches; mouthbrushes with simple hairs in 15/16 larvae examined, with pectinate setae in the remaining one; seta 5-C with 5-11 branches; 6-C usually with 3-5 branches (see under Taxonomic Discussion). *Abdomen*. Comb a mixture of about 13-23 scales (*cs*), with uniformly fringed apex, and spines with hypertrophied median denticle, the former predominating; siphon about 3.5 - 5.0 times the length of the saddle (about 5-8 times its breadth at base); pecten of 4-12 slender spines (*pt*), usually with the bases less expanded and the secondary denticles smaller than in *communis*; seta 1-S bifid; arising well beyond the distal pecten tooth, somewhat longer than the diameter of the siphon at point of attachment; saddle with apex lightly spiculate; seta 1-X usually bifid or trifid, sometimes longer and single; 2-X with 2-4 branches; 3-X single; anal papillae large, cylindrical, bluntly rounded at tip, the upper pair much longer than the lower; ventral brush with 6 setae in the barred area, 1-4 of these bifid (or one, rarely, trifid), the others single, and with 2 smaller setae arising outside the barred area.

TYPE DATA. *H. macdonaldi* Mattingly, holotype male and allotype female, on pins, with associated larval and pupal skins, in British Museum; type locality: Ulu Langat Forest Reserve, *Selangor*, WEST MALAYSIA. *H. nivirostris* Lien, holotype male and allotype female, with associated larval and pupal skins, in Provincial Malaria Research Institute, Taipei, Taiwan; type locality: Laitou, Fanlu, *Chiai*, TAIWAN.

DISTRIBUTION. Specimens examined: THAILAND, *Tak*, Doi Sam Sao 1 female, 1 larval skin, 1 pupal skin; *Ranong*, Kra Buri 1 male, 1 pupal skin; *Nakhon Si Thammarat*, Ban Thuan Lek 1 whole larva. WEST MALAYSIA, *Selangor*, Ulu Gombak 1 female, 1 larval skin, 1 pupal skin, Ulu Langat 7 females, 14 males, 12 larval skins, 12 pupal skins. TAIWAN, *Chiai*, Laitou 1 paratype female of *nivirostris*, 1 whole pupa with associated larval skin of same. Other Distribution. Recorded in TAIWAN only from the type locality of *nivirostris*.

TAXONOMIC DISCUSSION. Distinctions from *communis* have been discussed under that species. All identifiable larvae from the mainland seen by me have seta 6-C with 3 or more branches at least on one side. However, the only Taiwan larva available to me has this seta bifid on both sides and with one branch markedly smaller than the other. Distinction from *communis*, and even from *scintillans* and *funerea*, may not therefore always be possible. The female from Taiwan seen by me has a pale basal band on abdominal terga V-VII. In mainland specimens I have seen such a band on tergum VII only. This, however, is a variable character in so many species that I do not attach very much importance to it. None of the characters given by Lien for distinguishing *nivirostris* from the present species are reliable. All fall within the range of variation of my mainland material. I have not seen any males from Taiwan and Lien's figure of the terminalia shows no details of the ornamentation of the proximal claspette. So far as I can tell, however, there is no significant difference from the present species. I have therefore relegated *nivirostris* to the synonymy.

BIOLOGY. Breeding places include split and bored bamboos (Macdonald & Traub 1960) and a bamboo stump at 1000 m. (Lien 1968). The larva from Ban Thuan Lek came from a tree hole. Macdonald & Traub note a preference for dead or dying bamboos.

HEIZMANNIA (HEIZMANNIA) MATTINGLYI THURMAN
(Figs. 24, ♀ terminalia; 26, ♀)

Heizmannia mattinglyi Thurman 1959, Univ. Maryland Agric. Exp. Sta. Bull. A-100: 70 (♀).

Known only from the adult female. Apparently distinguished from all other species of the genus by the presence of pale scales on the lateral, as well as the median, lobes of the scutellum. It closely resembles *covelli* in other respects.

FEMALE. *Head.* Top of head dark except for the usual ventrolateral white patches and white spot between the eyes; eyes well separated; basal joint of antennal flagellum with dark scales; proboscis about equal in length to fore femur; palpus about one-seventh of the length of the proboscis; clypeus bare. *Thorax.* Scutal scales mainly bright gold with greenish reflections; prescutellar bristles absent; scutellum with white scales on all lobes and some dark scales intermixed; anterior pronotal lobes almost entirely pale scaled with some dark scales posteriorly; posterior pronotum dark scaled; postspiracular bristles absent; postnotum with a tuft of dark bristles. *Wing.* Plume scales narrow, broader on R_1 and R_2 ; cell R_2 about 3.0 - 3.5 times as long as its stem. *Legs.* Hind femur pale on about the basal four-fifths with dark dorsal stripe not quite reaching base. *Abdomen.* Tergum I dark; II-VI with basal lateral pale patches prolonged posteriorly along lateral edges on II and to some extent on III; segments II-VI otherwise dark or with more or less complete pale basal bands; VII with a complete pale basal band in all cases; sterna II and III apparently all pale; posterior sterna with apical dark bands. *Terminalia.* Apparently indistinguishable from those of *covelli*.

MALE, PUPA and LARVA. Not known.

TYPE DATA. Holotype female, on pin, with terminalia on slide, in U. S. National Museum; type locality: Rong Kwang, *Phrae*, THAILAND.

DISTRIBUTION. Specimens examined: THAILAND, *Phrae*, Rong Kwang 2 females; *Chiang Mai*, Prao 1 female, Chiang Mai 1 female, Doi Suthep 2 females, Chiang Dao 1 female; *Udon Thani*, unnamed locality 1 female; *Nan*, Ban Salik 1 female. CAMBODIA, Sre Klong 1 female, Prey Plidan 1 female. *Other Distribution.* The U. S. National Museum has a female, from Ban Pha Tak, *Chiang Mai*, THAILAND, attributed to this species but now fragmentary and no longer identifiable. Records other than from the type locality require confirmation.

TAXONOMIC DISCUSSION. The paratype from Rong Kwang has the abdomen missing. The remaining specimens differ from the holotype in the presence of conspicuous pale basal bands on abdominal terga II-VI. However, this is a variable character in some other species, notably *covelli*, and its taxonomic significance is doubtful. The holotype and paratype appear to have the plume scales narrower than in the other specimens but both have the wings badly rubbed. The only reliable distinction from *covelli* seems to be the presence of pale scales on the lateral lobes of the scutellum. The significance of this character cannot be properly assessed until associated material is available.

BIOLOGY. Adults were taken attacking man in jungle and bamboo forest and, in the case of the holotype and paratype, in partial shade on a hillside.

HEIZMANNIA (HEIZMANNIA) PERSIMILIS n. sp.
(Figs. 27, ♀; 28, ♂♀ terminalia, ♂ claws; 29, pupa, larva)

This is one of several species which may previously have been recorded as *greenii*. The others are *chengi*, *propinqua* n. sp., *proxima* n. sp. and *scanloni* n. sp. All of them have the posterior pronotum pale scaled and very narrow wing scales, a combination of characters previously considered diagnostic for *greenii*.

FEMALE. *Head.* Top of head dark except for pale ventrolateral patches and pale spot between eyes; basal joint of antennal flagellum with pale scales; proboscis relatively stout, about 1.1 times as long as front femur; clypeus bare, palpus about one-tenth to one-eighth of the length of the proboscis. *Thorax.* Scutal scales with metallic, mainly green reflection, blue in some lights; a small spot of broad, white scales on lateral edge, immediately in front of wing root; prescutellar bristles absent; scutellum entirely dark scaled; anterior pronotal lobes with a border of pale scales round the entire anterior and outer edge; posterior pronotum entirely pale scaled; postspiracular bristles absent; postnotum with a conspicuous tuft of moderately pale bristles. *Wing.* Plume scales all very narrow; cell R_2 about 2.3 - 2.8 times as long as its stem. *Legs.* Hind femur pale on about the basal four-fifths; all tarsal claws simple. *Abdomen.* Terga I-IV all dark above or IV with a small median basal pale spot; remaining terga dark above or with more or less complete, narrow pale basal bands; tergum II with squarish basal lateral pale patches extending back to the posterior border; III-VI with triangular basal lateral pale patches tending to be prolonged posteriorly on anterior, and inwards towards center on posterior segments; sterna III-VII with broad, dark apical bands. *Terminalia.* Postgenital plate with rounded apex; postatrial plates strongly sclerotized.

MALE. *Head.* Antenna with the 2 terminal joints elongated as usual. *Legs.* One fore tarsal claw with a tooth arising near base; the other simple; both mid tarsal claws simple. *Terminalia.* Distimere without special features, very much as in *proxima* n. sp.; apex of basimere with a single row of narrow, slightly flattened setae; subapical lobe with a single spine; distal claspette (*dcl*) with 2 pilose lobes, without harpago, very much as in *propinqua* n. sp. and *proxima* n. sp.; proximal claspette (*pcl*) with numerous setae; a few of which are stouter than the rest while others are greatly elongated; paraprocts with 1 large and 1-2 smaller teeth at apex; IXth tergum with lobes closely approximated, each with 4-6 delicate hairs; IXth sternum completely sclerotized with 1-2 stout bristles at apex.

PUPA. *Cephalothorax.* Seta 6-C single, shorter than 7-C which is single or bifid. *Abdomen.* Seta 1-II relatively conspicuous, with several primary branches, one or more of which may show secondary branching; 5-II very slender, single or bifid; 9-II-VI minute; 5-IV variable, usually about as long as the following segment, occasionally only half as long; 5-V longer than the following segment; 5-VI about as long as the following segment or a little shorter; 9-VII single; 9-VIII bifid or trifid. *Paddle.* About 1.6 - 2.3 times as long as its greatest breadth; fringe tending to be less extensive than in most

species, with fine hairs and a few spicules inside these; seta 1-P single; male genital sac with well marked horns.

LARVA. *Head.* Antenna variable in length, curved, spiculate; seta 1-A arising shortly before half way in those larvae with short, and slightly beyond half way in those larvae with long, antennae, with 3-4 branches; mouth-brushes without pectinate setae; seta 5-C with 6-13 branches; 6-C single or, more usually, with 2 very unequal branches. *Abdomen.* Comb with 16-28 teeth (*cs*), comprising mixed scales, with more or less uniform fringe, and spines with hypertrophied median denticle; siphon about 3.0 - 3.7 times the length of the saddle (about 3.7 - 4.5 times its breadth at base); pecten of 5-10 teeth (*pt*), some simple, others with well developed basal denticles; seta 1-S with 2-3 branches, longer than diameter of siphon at point of attachment, arising just beyond terminal pecten tooth; saddle with apex strongly spiculate; seta 1-X single; 2-X single to trifid, usually bifid; 3-X single; anal papillae long, bluntly rounded at tip, narrower than in most species; ventral brush with 6 setae in the barred area and 1-2 precratal setae, all single or bifid.

TYPE DATA. Holotype male, on pin, with terminalia and associated larval and pupal skins on slides, in British Museum; type locality: 15th mile, Ulu Gombak, *Selangor*, WEST MALAYSIA.

DISTRIBUTION. Specimens examined: THAILAND, *Tak*, Khao Salak Phra 7 females, 6 males, 6 larval skins, 13 pupal skins. WEST MALAYSIA, *Selangor*, Ulu Gombak 3 females, 2 males, 2 larval skins, 2 pupal skins.

Other Distribution. The following unassociated specimens are provisionally attributed to the present species, though excluded from the paratype series. THAILAND, *Chiang Rai*, Doi Sam Sao 3 whole larvae; *Ranong*, Ko Chang Is. 1 larval skin, 1 pupal skin; *Nakhon Nayok*, Pha Klory Mai 1 pupal skin. WEST MALAYSIA, *Selangor*, Ulu Gombak 1 female. VIETNAM, An Tuc 1 female, Cam Ranh 26 females.

TAXONOMIC DISCUSSION. Specimens from Vietnam, tentatively placed under this species, by reason of the pale scaled posterior pronotum, have the wing scales rather broader than in topotypic *persimilis* n. sp. They also show a tendency to prolongation of the apical dark area along the underside of the hind femur, approaching *scintillans* in both respects. They can at present only be provisionally ascribed. As noted above, this species may formerly have been confused with *greenii*. It seems, however, to be more closely related to *scintillans*, as also do *propinqua* n. sp. and *proxima* n. sp.

BIOLOGY. The paratypes from Khao Salak Phra were bred out from a tree hole in primary rain forest at 2700 ft. The whole larvae from Doi Sam Sao and the pupa from Ko Chang Is., provisionally attributed to the present species, were found in holes in tree stumps in forest. Some Malayan adults were bred out from a tree hole about 6 ft. above ground, containing 'peaty' water. Others were taken on man.

HEIZMANNIA (HEIZMANNIA) PROPINQUA n. sp.
(Figs. 30, ♀; 31, ♂ terminalia, claws; 32, pupa, larva)

Closely resembles *persimilis* n. sp. and *proxima* n. sp. but differs from both in the ornamentation of the apex of the male basimere and proximal claspette.

FEMALE. *Head.* Top of head with pale scales largely confined to the median and ventrolateral spots but with a few pale-tipped scales round eye margins; basal joint of antennal flagellum with pale scales; proboscis relatively stout, approximately equal in length to fore femur; clypeus bare; palpus about one-sixth of the length of the proboscis. *Thorax.* Scutal scales with rather dull, mainly green reflection but distinctly metallic (in contrast to *complex*), much as in *persimilis* n. sp.; prescutellar bristles absent; all lobes of scutellum dark scaled, upper surface of anterior pronotal lobes dark except for a rim of whitish scales round the anterior border; posterior pronotum entirely pale scaled; pleuron with the usual ornamentation of broad, white scales; postspiracular bristles absent; postnotum with a small tuft of pale bristles. *Wing.* All plume scales narrow; cell R_2 about 2.5 times as long as its stem. *Legs.* Anterior surface of hind femur with a broad creamy stripe on about the basal five-sixths; dark dorsal stripe continued to base. *Abdomen.* Terga I-VI nearly all dark above; II-VI with large, creamy basal lateral triangles, prolonged backwards along the ventrolateral edge on II-V; VII and rest of abdomen missing; sterna with dark apical bands except, apparently, on II. *Terminalia.* Missing.

MALE. *Head.* Antenna with the 2 terminal joints elongated as usual. *Legs.* One fore tarsal claw with a long, slender tooth at base; the other simple; both mid tarsal claws simple. *Terminalia.* Distimere with part of outer edge folded, producing a small spur; apex of basimere with 2 rows of slightly flattened setae, the proximal row longer; subapical lobe single with a long, stout, sinuous spine; proximal claspette (*pcl*) with a tuft of relatively short, flattened setae, several of which are twisted and darker than the remainder, and with about 5 longer setae, with leaf-like distal expansions, apparently fused at base, arising from a small apical projection; distal claspette (*dcl*) with 2 pilose lobes devoid of ornamentation; paraprocts with 1 large and 1 small tooth at apex; IXth tergum as figured; IXth sternum uniformly sclerotized, without median lobe.

PUPA. *Cephalothorax.* Seta 6-C shorter than 7-C, bifid; 7-C bifid on one side, single on the other. *Abdomen.* Seta 1-II with 8 very delicate branches; 5-II small, delicate, single; 9-II-VI minute; 5-IV-VI single, about equal in length to the following segments on IV and VI, about half as long again on V; 9-VII single; 9-VIII bifid on one side, trifid on the other. *Paddle.* About 1.9 times as long as its greatest breadth; fringe relatively short and delicate; seta 1-P single.

LARVA. *Head.* Antenna moderately long, curved, spiculate; seta 1-A with 2-3 branches, arising well before half way; inner mouthbrush setae relatively slender but pectinate; seta 5-C with 5-6 branches; 6-C with 2 branches, one much stouter than the other. *Abdomen.* Comb a patch of 20-24

teeth (*cs*), some with hypertrophied median denticle, others with uniform fringe, the denticles in all cases relatively coarse; siphon about 3.5 times as long as saddle (about 4.5 times its breadth at base); pecten with 6-9 teeth (*pt*), all with secondary denticles which are most conspicuous on the more distal teeth; seta 1-S bifid, with one branch split distally, longer than the diameter of the siphon at point of attachment, arising just beyond the distal pecten tooth; saddle with upper portion of distal edge strongly spiculate; seta 1-X missing; 2-X bifid; 3-X single; anal papillae broad, cylindrical, bluntly rounded at tip; the lower pair slightly longer than the upper; ventral brush with 6 setae in the barred area and 2 smaller precratal setae; none of these with more than 2 branches.

TYPE DATA. Holotype male and allotype female on pins in British Museum, the latter with associated larval and pupal skins; type locality: Ulu Gombak, *Selangor*, WEST MALAYSIA.

DISTRIBUTION. Specimens examined: WEST MALAYSIA, *Selangor*, Ulu Gombak 1 female with associated larval and pupal skin, 1 male. *Other Distribution*. A whole larva from Ban Pha Man, THAILAND, in the U. S. National Museum, agrees with the above description and may belong to the present species but the record requires confirmation. A female from Ko Chang, *Ranong*, THAILAND, also in the U. S. National Museum, similarly agrees but could belong to *scanloni* n. sp. the female of which is unknown. (See under Taxonomic Discussion, below).

TAXONOMIC DISCUSSION. As already noted (p. 30), this is one of a group of species any or all of which may previously have been confused with *greenii*. Among these its closest affinities, to judge from the male terminalia, would be with *persimilis* n. sp. and *proxima* n. sp. The whole larva from Ban Pha Man, mentioned above, keys to the present species but differs as follows: seta 5-C with 7-8 branches; spines at bases of pleural setae slightly larger; comb with 10-12 teeth; siphon about 3.2 times as long as saddle; pecten with 5-6 teeth; seta 1-S bifid; distal edge of saddle very lightly spiculate; seta 1-X bifid; anal papillae missing. In view of the fact that several of its relatives are so imperfectly known it seems desirable to query records from Thailand until these can be supported with males.

BIOLOGY. The paratype female was bred out from a tree hole, about 3 ft. above the ground, containing clean water and sediment. The larva from Ban Pha Man came from a bamboo stump.

HEIZMANNIA (HEIZMANNIA) PROXIMA n. sp.
(Figs. 33, ♂; 31, ♂ terminalia, claws; 34, pupa, larva)

This species is known only from 2 adult males with associated larval and pupal skins. It is one of several species (*chengi*, *persimilis* n. sp. and *scanloni* n. sp. are others) which may previously have been confused under the name *greenii*.

FEMALE. Not known.

MALE. *Head*. Top of head with pale scales confined to ventrolateral patches and a median triangular spot between eyes; basal flagellomeres with a conspicuous spot of pale scales on inner surface; terminal and subterminal joints greatly elongated; proboscis slender, approximately equal in length to fore femur; clypeus bare; palpus about one-eighth of the length of the proboscis. *Thorax*. Scutum covered with very broad metallic scales with dark blue and green reflections; prescutellar bristles absent; scutellum with dark scales only; anterior pronotal lobes dark scaled except round anterior border; posterior pronotum with pale scales only; no postspiracular bristles; postnotum with a tuft of pale bristles. *Wing*. All plume scales very narrow; cell R_2 about 1.8 - 2.0 times the length of its stem. *Legs*. Hind femur pale below, on anterior surface, nearly to tip; fore tarsus with one claw simple; the other with a moderately stout tooth near base; both mid tarsal claws simple. *Abdomen*. Terga I-VI dark above with whitish basal lateral triangle prolonged posteriorly along ventrolateral edges. *Terminalia*. Distimere very much as in *persimilis* n. sp.; apex of basimere with a row of 6 setae, represented in the available material only by their sockets; subapical lobe with a single stout spine; distal claspette (*dcl*) with 2 pilose lobes; without harpago, very much as in *persimilis* n. sp. and *propinqua* n. sp.; proximal claspette (*pcl*) as in *persimilis* n. sp. but with all setae in the main tuft approximately equal in length and with about 5 of them stouter and darker than the remainder; a small separate lobe; with 2 long setae, present, as in *persimilis* n. sp. and *propinqua* n. sp.; paraprocts with 2 coarse teeth at tip; IXth tergum not well seen, apparently much as in *persimilis* n. sp. and *propinqua* n. sp.; IXth sternum completely sclerotized; a stout bristle arising near apex.

PUPA. *Cephalothorax*. Seta 6-C shorter than 7-C, single; 7-C single or bifid. *Abdomen*. Seta 1-II relatively inconspicuous, with about 1-3 primary and several delicate secondary branches; 5-II about equal in length to 2-II or longer, but much more slender; 9-II-VI minute; 5-IV about equal in length to the following segment; 5-V somewhat longer; 5-VI about half the length of the following segment; all of these single; 9-VII and 9-VIII single and single or bifid respectively. *Paddle*. About 2.1 - 2.2 times as long as its greatest breadth; fringe relatively short and scanty; seta 1-P single; male genitalic sac with apical horns clearly differentiated.

LARVA. *Head*. Antenna moderately long, curved, spiculate; seta 1-A with 3-4 branches; mouthbrushes without pectinate setae; seta 5-C with 6-7 branches; 6-C single, expanded just beyond base, or with 2 very unequal branches. *Abdomen*. Comb a patch of 14-22 spines with greatly hypertrophied median denticle; siphon about 3.5 times the length of the saddle (about 4.5 times its breadth at base); pecten of 5-9 slender teeth, all or most of them with small or very small secondary denticles at base; seta 1-S with 2 slender branches, arising just beyond distal pecten tooth; saddle with upper portion of distal edge strongly spiculate; seta 1-X single; 2-X bifid; 3-X single; ventral brush with 6 setae in the barred area, all single or bifid, and 1 smaller precratal seta.

TYPE DATA. Holotype male on pin, with terminalia on slide, in U. S. National Museum; type locality: Doi Inthanon, *Chiang Mai*, THAILAND.

DISTRIBUTION. Specimens examined: THAILAND, *Chiang Mai*, Doi Inthanon 2 males with associated larval and pupal skins. *Other Distribution.* Two whole larvae from Ban Thuan Lek and Ban Pha Man, respectively, and 9 whole larvae from Ban Wang Mo, THAILAND, may belong to this species or a closely related form (see below).

TAXONOMIC DISCUSSION. This species is evidently closely related to *persimilis* n. sp. and *propinqua* n. sp., differing from the former in the ornamentation of the proximal claspette of the male, from the latter in the male distimere and from both in the shape of the larval comb spines. The larvae from Ban Thuan Lek etc., noted above, key to the present species but differ as follows: mouthbrushes dimorphic, either with or without pectinate setae; antenna longer in the second case (cp. *communis*, p. 15); seta 1-A single to tetrafid; 5-C with 3-11 branches; 6-C trifid on one side of one larva, the branches in most cases subequal; comb with 12-18 teeth; siphon 2.6 - 3.2 times as long as saddle; pecten with 4-10 teeth; secondary denticles minute or absent in most cases; seta 1-S bifid or trifid; distal edge of saddle smooth or almost so.

BIOLOGY. Holotype and paratype bred out from a tree hole. The other larvae came from a split bamboo, bamboo stump and stump hole.

***HEIZMANNIA (HEIZMANNIA) REIDI* MATTINGLY**
(Figs. 35, ♀; 36, ♂♀ terminalia, ♂claws; 37, pupa, larva)

Heizmannia reidi Mattingly 1957, Cul. Mosq. Indomalay. Area 2: 38 (♂*, ♀*).
Phoniomyia indica Leicester 1908, Stud. Inst. med. Res. F. M. S. 3(3): 253;
Edwards 1922, Indian J. med. Res. 10: 447; Barraud 1929, Ibid.,
17: 265 and 1934, Fauna Brit. India (Dipt.) 5: 303, *nec* Theobald.
Heizmannia cheni Lien 1968, Trop. Med., Nagasaki, 10: 135 (♂*, ♀*, P*, L*).
NEW SYNONYMY.

This is a particularly widespread and common species. It is readily distinguished by the unusually long, slender proboscis and long upper fork cell. The larvae, also are quite unlike those of any other species, particularly as regards the comb.

FEMALE. *Head.* Eyes well separated behind; top of head with the usual basal lateral white patches and patch of white scales between eyes; eye margins without white scales; basal joint of antennal flagellum with pale scales and a few dark ones; proboscis about 1.2 - 1.4 times as long as fore femur; palpus about one-tenth to one-eighth of the length of the proboscis; clypeus bare. *Thorax.* Scutal scales with metallic reflection, tinged, in some specimens, mainly with blue, in others mainly with red; no prescutellar bristles; scutellar scales usually all dark (but see below under Taxonomic Discussion); anterior pronotal lobes with a large patch of silvery scales occupying most of the upper surface; a few dark scales behind and at inner corner; posterior pronotum dark scaled; postspiracular bristles usually absent; a single pale bristle sometimes present; postnotum with a well developed tuft of dark

bristles. *Wing*. Plume scales broad or moderately broad; cell R_2 about 2.7 - 3.7 times as long as its stem. *Legs*. Hind femur pale below on basal five-sixths or more of anterior surface with dark dorsal stripe reaching to base. *Abdomen*. First tergum with laterotergite entirely pale, otherwise dark; remaining terga above with basal lateral triangular pale patches, reaching the distal edge of the tergum along the ventrolateral border only on tergum II, sterna with dark apical bands except on II. *Terminalia*. Postgenital plate rounded at apex; postatrial plates strongly sclerotized.

MALE. *Head*. Antenna normally as in other species of the genus (but see under Taxonomic Discussion). *Legs*. Both fore tarsal claws strongly toothed at base; one with a longer tooth than the other; both mid tarsal claws simple. *Terminalia*. Distimere complex, with a well developed, transparent, lightly pilose 'tail'; apex of basimere with a row of 3-4 short, flattened, striated setae; subapical lobe with a single stout spine; distal claspette with a well developed harpago having a finely attenuated appendage, and with a fan-shaped bunch of short, slightly modified setae bent at the tips; proximal claspette with a dense patch of moderately long, fine setae and a tuft of longer, somewhat flattened setae with tips recurved; paraprocts with attenuated tips; IXth sternum strongly sclerotized over almost the whole of its area but with a distinct median lobe.

PUPA. *Cephalothorax*. Seta 6-C single, shorter than 7-C which is single to tetrafid. *Abdomen*. Seta 1-II with delicate primary branching, usually abundant, and some secondary branching; 5-II small and delicate, single to tetrafid; 9-II-VI minute; 5-IV from 0.6 - 1.7 times the length of the following segment; all 3 single; 9-VII single to pentafid; 9-VIII with 3-13 branches. *Paddle*. About 1.5 - 3.0 times as long as its greatest breadth, with long fringe of hair-like spicules and inside this a multiple row of shorter spicules; seta 1-P single, very occasionally split at tip; male genital sac usually with well marked horns.

LARVA. *Head*. Antenna long, slender, curved, usually varying only slightly with the type of mouthbrushes; spiculate for most of their length; seta 1-A with 3-8 branches; mouthbrushes either with or without pectinate setae (see under Taxonomic Discussion); seta 5-C with 5-10 branches; 6-C with 2 unequal branches, rarely single or trifid. *Abdomen*. Comb a patch of about 30-60 scales, uniformly fringed at apex; siphon about 2.5-4.0 times as long as its breadth at base, about 2.4 - 3.0 times the length of the saddle; pecten of 5-15 stout teeth, each with a conspicuous basal denticle, with or without additional smaller denticles; seta 1-S arising just beyond distal pecten tooth, with 4-8 branches, somewhat longer than diameter of siphon at point of attachment; saddle with distal edge almost entirely smooth; seta 1-X variously developed, single to tetrafid; 2-X with 3-7 branches; 3-X single; anal papillae relatively narrow, very variable in length, the upper pair slightly longer than the lower, the apices pointed; ventral brush with 8 multi-branched setae, 7 of them, at least, with barred sockets, 1-2 of the anterior ones often displaced posteriorly and arising level with, and to one side of, the main barred area in both Malayan and Thailand specimens.

TYPE DATA. *H. reidi* Mattingly, holotype male on pin in British Museum; type locality: Sukna, *N. Bengal*, INDIA; allotype female on pin in British Museum; type locality: Tindharia, *N. Bengal*, INDIA. *H. cheni* Lien, holotype male and allotype female, with associated larval and pupal skins, in Taiwan Provincial Malaria Research Institute, Taipei, Taiwan; type locality: Feng-chihu, Chuchi Township, *Chiai*, TAIWAN.

DISTRIBUTION. Specimens examined: INDIA, *North Bengal*, Sukna 1 male, Tindharia 1 male, 4 females, Marriambarrie 1 female, Kurseong 1 male, Sureil 2 males. UPPER BURMA, Nam Tamai Valley (27° 42' N., 97° 54' E.) 1 female. THAILAND, *Chanthaburi*, Khao Saidao 8 males, 3 females, 4 whole larvae, 6 larval skins, 9 pupal skins, Ban Thuan Lek 3 males, 3 females, 3 whole larvae, 4 pupal skins, Chaung Khao 1 whole larva; *Nakhon Nayok*, Pha Klory Mai 4 males, 3 females, 1 whole larva, 7 larval skins, 8 pupal skins, Muang 1 female; *Lamphun*, Kang Arb Nang 1 female; *Nakhon Si Thammarat*, Khao Luang Banna 5 females, Khao Keo Banna 3 females; *Chiang Mai*, Doi Suthep 7 females, 4 males, 9 whole larvae, 3 larval skins, 4 pupal skins; *Phatthalung*, Muang 1 male, 6 females, 6 larval skins, 7 pupal skins; *Tak*, Khao Salak Phra 1 male, 1 larval skin, 1 pupal skin; *Nakhon Ratchasima*, Korat (Pak Chong) 2 females, 1 male, 3 whole larvae, 1 pupal skin; *Phangnga*, Doi Sam Sao 1 male, 3 female, 1 larval skin, 3 pupal skins, Thapwen 6 females, 1 male, 2 larval skins, 7 pupal skins, Pathum Thani 2 females, 2 males, 2 larval skins, 2 pupal skins; *Ranong*, Ban Chatri 22 females, 21 males, 42 pupal skins, 10 larval skins. WEST MALAYSIA, *Selangor*, Ulu Gombak, 4 males, 16 females, 8 larval skins, 8 pupal skins, Kuala Lumpur (Pahang Road) 1 male, 1 female. VIETNAM, Long Khanh, Xuan Loc 2 females, 2 larval skins, 2 pupal skins. TAIWAN, Chuchi 2 males, 2 females with associated larval and pupal skins. *Other Distribution*. Probably the species recorded by Causey (1937: 414) from northern THAILAND as *indica*. Additional records from TAIWAN include Fanlu, Paiho and Hsiulin (Lien 1968).

TAXONOMIC DISCUSSION. *H. cheni* appears to be identical in all significant respects with the present species. *H. indica*, confused with it by previous authors, is quite different (Mattingly 1957 and see p. 25). The distal claspette and paraprocts recall *macdonaldi* but this differs in many other respects. A specimen from Kuala Lumpur with male terminalia and female antennae is presumably a gynandromorph. Mouthbrush dimorphism is common though associated modifications of the antenna are not well marked. A few larvae with very strongly pectinate mouthbrushes have unusually short antennae. In some Malayan specimens a few scales on the mid lobe of the scutellum appear pale in certain lights. One specimen from Vietnam has a white spot in this position. The other has the scutellum rubbed.

BIOLOGY. The Malayan larvae were obtained from eggs laid by wild caught females in the laboratory. Breeding places in Thailand include tree holes, bamboo internodes, a bamboo pot, a banana tree, ground pools, a rock hole and a crab hole. The Vietnam larvae came from a tree hole, those from Taiwan from a bamboo stump. Adults have been taken in a light trap and on man.

HEIZMANNIA (HEIZMANNIA) SCANLONI n. sp.
(Fig. 38, ♂ terminalia)

This species is known only from a unique male adult, in very poor condition except for the terminalia which are quite different from those of any other species. It is one of several species which may previously have been recorded from Thailand under the name of *greenii*.

FEMALE. Not known.

MALE. *Head*. Top of head denuded; antennae missing; proboscis broken before tip but apparently long and slender; clypeus bare. *Thorax*. Scutum and scutellum entirely denuded; anterior pronotum and posterior pronotum denuded except for a few broad white scales which suggest that both may be extensively pale scaled; some dark scales posteriorly on anterior pronotum; postnotum with some very pale bristles and a single broad scale. *Wing*. Greatly denuded, remaining plume scales all narrow or very narrow; cell R_2 about 2 times as long as its stem or slightly less. *Legs*. All tarsi and the whole of both hind legs missing. *Abdomen*. Missing except for the terminalia which were remounted on a slide. *Terminalia*. Distimere as figured; apex of basimere with a dense tuft of flattened, contorted setae with finely attenuated tips, some pointed, other blade-like, still others racket-shaped; subapical lobe with 2 stout spines, one slightly smaller than the other; proximal claspette with dense tuft of long, flattened setae; distal claspette broad, membranous, pilose with 2 arms, one with a group of short spines at base and a single more delicate spine near apex (possibly representing the harpago), the other with a blunt sclerotized appendage somewhat as in *persimilis* n. sp. (p. 30); apex of paraproct with 4 small teeth; IXth tergum with well separated lobes, one with 3, the other with 4 fine hairs; IXth sternum extensively sclerotized but with well defined broad median lobe and, apparently, 3 bristles behind apex.

PUPA and LARVA. Not known.

TYPE DATA. Holotype male, on pin, with terminalia on slide, in U. S. National Museum; type locality: Ban Chang Kien, *Chiang Mai*, THAILAND.

DISTRIBUTION. Known only from the holotype.

TAXONOMIC DISCUSSION. Despite the poor condition of the only available specimen, there can be no doubt, from the terminalia, that this is a very distinct species. The remarkable flattened setae at the apex of the basimere recall *achaetae* and, to a less extent, *aureochaeta*, as does the feeble development of postnotal hairs. Aedine features are less pronounced than in *achaetae*, but certain features of the distal claspette recall subgenus *Paraedes*. It is possible that the early stages, when discovered, may share some of the features of *achaetae* and *aureochaeta*. The female, when found, may well prove to have some loosely attached broad scales on the postnotum, as in *complex*. The only scale remaining in this position in the holotype does not appear to have arrived by transport.

BIOLOGY. The only known specimen was taken in a light trap in a garden.

HEIZMANNIA (HEIZMANNIA) SCINTILLANS LUDLOW
(Figs. 1, ♂; 39, ♂♀; 40, ♂♀ terminalia, ♂ claws; 41, pupa, larva)

Heizmannia scintillans Ludlow 1905, Canad. Ent., 37: 130 (♀).

Heizmannia pilosa Brug 1931, Tijdschr. Ent., 74: 245 (♂*).

This is a widespread and common species. Females are distinguishable from those of other species, except *funerea* and *indica* by the prolongation of the apical dark band on the hind femur ventrally, as well as dorsally, towards the base. Females of *indica* appear to differ mainly in the predominantly blue reflection from the scutal scaling and the truncated basal lateral pale triangles on the abdominal tergites. Females of *funerea* differ in having the pale spot on the anterior border of the anterior pronotal lobes almost completely suppressed. Both differ from *scintillans* in the male terminalia. The larvae of *scintillans* and *funerea* appear to be indistinguishable and those of *persimilis* and *propinqua* also resemble them closely. The larva of *indica* is unknown.

FEMALE. *Head.* Top of head dark except for the pale ventrolateral patches and pale spot between eyes; no pale scales round eye margins; basal joint of antennal flagellum with pale scales and a few small, dark ones; proboscis slender, about 1.1 - 1.2 times as long as fore femur; clypeus bare; palpus about 0.1 - 0.2 of the length of the proboscis. *Thorax.* Scutal scales with metallic-gold reflection tinged with red, blue and green, usually with blue and green predominating, occasionally red; prescutellar bristles absent; scutellum entirely dark scaled except in one specimen from Malaya and three from Vietnam which have a small spot of white scales at the apex of the mid lobe; anterior pronotum with a variable amount of pale scaling, sometimes restricted to the anterolateral corner, sometimes covering most of the lobe, but always with some dark scaling behind; posterior pronotum wholly dark; postspiracular bristles absent; postnotum with a well developed tuft of bristles. *Wing.* Plume scales mostly narrow, broader on R₂ and R₃; cell R₂ normally about 2.0 - 2.5 times as long as its stem (see under Taxonomic Discussion). *Legs.* Hind femur with a well developed dark dorsal stripe extending to base and with a dark ventral stripe variously developed; sometimes failing to reach base; apical 0.2 - 0.3 of anterior surface entirely dark; first hind tarsal segment generally pale for some distance below though less so than in the male; all tarsal claws simple. *Abdomen.* Tergum I dark; laterotergite white scaled; terga II-VI dark above with triangular basal lateral pale patches prolonged inwards but not meeting in mid line; VII with or without a basal pale band or spot; the basal lateral pale spot on II prolonged along the ventrolateral border to the posterior edge of the segment; the corresponding spot less extensively prolonged, if at all, on the other segments; sternum II all pale or with narrow dark apical band; III-VI or sometimes VII with broad dark apical bands. *Terminalia.* Postgenital plate rounded at apex; postatrial plates strongly developed.

MALE. *Head.* Antenna of normal male type with the 2 terminal segments greatly elongated. *Legs.* Second hind tarsomere with a longitudinal

row of sub-erect scales; third hind tarsal segment with a conspicuous row of erect scales, becoming sub-erect towards apex of segment; fore tarsus with one claw simple, the other with a small tooth at base; mid tarsal claws both simple. *Terminalia*. Distimere complex; apex of basimere with a row of conspicuous, flattened, leaf-like setae; subapical lobe with a single spine; distal claspette recalling that of *indica* (p. 25) but neither group of setae with hooked tips; proximal claspette also recalling that of *indica* but much more strongly setose and without the fimbriated appendage characteristic of that species; paraprocts strongly sclerotized and toothed; IXth sternum completely sclerotized.

PUPA. *Cephalothorax*. Seta 6-C single; 7-C less than 2 times as long as 6-C, single to trifid. *Abdomen*. Seta 1-II with expanded base and fine primary branches which may be numerous but which show little or no secondary branching; seta 5-II small, delicate, single or bifid; 9-II-VI minute; 5-IV from 0.7 - 1.5 times as long as the following segment, single; 5-V from 1.1 - 1.5 times as long as the following segment, single, occasionally split at tip; 5-VI from 0.7 - 1.2 times as long as the following segment (0.5 times in one specimen), also occasionally split at tip; 9-VII single in all cases; 9-VIII single to tetrafid. *Paddle*. From about 1.8 - 2.5 times as long as its greatest breadth; fringe a double row of moderately long hairs with some shorter ones; a few very small spicules inside the fringe; seta 1-P single, occasionally split at tip; male genital sac frequently bluntly rounded at apex, without the apical horn characteristic of some other species.

LARVA. *Head*. Antenna variable, shorter in larvae with pectinate mouthbrush setae (cp. *reidi*, p. 35); seta 1-A single or bifid, rarely trifid, in larvae with pectinate mouthbrushes, with 2-6, usually 3-6 branches in those with filter feeding mouthbrushes; mouthbrushes dimorphic, with inner setae pectinate in all but 2 of the Malayan larvae, non-pectinate in all but 2 of the Thailand larvae and in those from Singapore and Sumatra; seta 5-C with 3-16 branches, usually with 10 or more; 6-C normally with 2 unequal branches, occasionally single, or with one of the branches split, on one side. *Abdomen*. Comb with 10-24 mixed scales, with uniformly fringed apex, and spines with hypertrophied median denticle; siphon about 2-4 times as long as saddle (about 2 - 4.5 times as long as its breadth at base); pecten with 2-9 large, simple teeth; secondary denticles minute or absent; seta 1-S single to trifid, longer than diameter of siphon at point of attachment; saddle with distal edge at least lightly spiculate; seta 1-X single or bifid; 2-X bifid, rarely trifid; 3-X single; anal papillae large, cylindrical, bluntly rounded at tip; ventral brush with 6 setae in barred area and 2 precratal setae, all either single or bifid.

TYPE DATA. *H. scintillans* Ludlow, holotype female, on pin, in U. S. National Museum; type locality: Camp Stotsenberg, Angeles, Pampanga, Luzon, PHILIPPINES. *H. pilosa* Brug, holotype male, on pin, with terminalia on same mount and wing and associated larval and pupal skins on slides in British Museum; type locality: Dermajoe, near Benkoelen, Sumatra, INDONESIA.

DISTRIBUTION. Specimens examined: WEST MALAYSIA, *Selangor*, Ulu Gombak 13 males, 26 females, 20 pupal skins, 20 larval skins, Kuala Lumpur 1 female, Puchong Road 1 male, 1 female, 2 pupal skins, 2 larval skins; *Perak*, Cameron's Highlands 1 female; *Pahang*, Kuantan 2 males. EAST MALAYSIA, *Sarawak*, Kuching 3 females, Long Tebangan 1 female, Gunong Matang 1 female; *Kalimantan*, Tarakan 1 female. SINGAPORE 1 male, 1 female, 1 pupal skin, 1 larval skin. INDONESIA, *Sumatra*, Dermajoe 2 males, 2 pupal skins, 2 larval skins. PHILIPPINES, Unnamed locality 1 female; *Leyte*, Mt. Lob 1 female; *Luzon*, Calaccad 2 females, Camp Stotsenberg 1 female, Los Banos 1 female, Mt. Isarog 1 male; *Mindanao*, Dansalan 1 female, Cagayan 1 female; *Palawan*, Puerta Princesa 3 females. THAILAND, *Nakhon Nayok*, Pha Klory Mai 2 males, 2 females, 6 pupal skins, 2 larvae, 1 larval skin, Sariga Village 1 female, Khao Yai 1 male, 1 female; *Nakhon Ratchasima*, Korat 2 males, 11 females, 34 pupal skins, 51 larvae, 23 larval skins, Nakornsajasima 1 female; *Songkla*, Boriphat Waterfall 1 female; *Ranong*, Unnamed locality 1 female; *Trat*, Ko Chang Is. 2 females, Lam Ncob 1 male; *Chanthaburi*, Chaung Khae 1 larva; *Chiang Mai*, Ban Patok 1 female; *Khon Kaen*, Padong Larn 3 females; *Phatthalung*, Unnamed locality 1 female; *Chumphon*, Ranong 1 larva; *Chon Buri*, Bang La Mung 1 female. VIETNAM, Con Son 27 females. CAMBODIA, Kirirom 2 males. *Other Distribution.* This is, perhaps, the species recorded by Borel (1930), as *greenii* from Xuan Loc, VIETNAM.

TAXONOMIC DISCUSSION. The discovery of the male from Mt. Isarog, Luzon, the first from the Philippines, has confirmed the synonymy previously arrived at on the basis of females only. Records from Vietnam still require confirmation from males and early stages. Three females from Con Son have a small spot of white scales at the apex of the mid lobe of the scutellum but so do 2 females from Thailand so that this may be a variable character as in some other species. The ratio of cell R_2 to the length of its stem is constant within the limits stated except that the specimen from Cameron's Highlands has a ratio of about 3 times while the specimen from Gunong Matang has a ratio of about 1.75 times. The reflections from the scutal scales are usually blue, green and gold but some Malayan and Vietnamese specimens have them strongly tinged with red. (cp. *reidi*).

BIOLOGY. Adults bite man in forest. Breeding places includes tree holes, bamboo internodes and a banana axil.

HEIZMANNIA (HEIZMANNIA) TAIWANENSIS LIEN
(Figs. 5, ♀; 42, ♂♀ terminalia, ♂ claws; 43, pupa, larva)

Heizmannia taiwanensis Lien 1968, Trop. Med., Nagasaki, 10: 137 (♂*, ♀*, P*, L*).

This species is related to *greenii*, *lii* Wu and *kanhsiensis* Tung. Differences are noted below under Taxonomic Discussion.

FEMALE. *Head.* Top of head with patches of broad white scales at sides and between eyes, the former extending for a short distance round eye margins; basal joint of antennal flagellum with pale scales; palpus dark, between 0.1 - 0.2 the length of the proboscis; proboscis slender, slightly shorter than fore femur, dark with a small pale spot below at extreme base. *Thorax.* Scutal scales with dull bronze reflection; some pale scales in pre-scutellar area and on mid lobe of scutellum; lateral lobes of scutellum entirely dark scaled; a small pale spot in front of wing root; postnotum with a group of pale setulae and 2 broad pale scales; anterior pronotal lobes pale scaled anteriorly, narrowly dark behind; posterior pronotum covered with broad pale scales. *Wing.* Plume scales narrow; cell R_2 about 3.0 - 3.5 times as long as its stem. *Legs.* Hind femur pale anteriorly on about the basal four-fifths or more with a dark ventral stripe and a broad dark dorsal stripe both reaching to base. *Abdomen.* Laterotergite pale scaled; terga II-VI with basal lateral pale triangles prolonged backwards along ventral edge, reaching posterior edge of tergite only on II and III; these patches also prolonged inwards towards mid line, forming a complete pale basal band on VI; tergum VII with a narrow basal pale band; terga III-V with or without median basal pale spots; sterna not seen. *Terminalia.* Without special features.

MALE. *Head.* Antenna with the 2 distal joints greatly elongated; verticillary hairs scanty. *Legs.* Fore tarsal claws subequal; one with a stout tooth arising near base; the other simple; one mid tarsal claw simple; the other represented by a curved, striated scale-like structure. *Terminalia.* Distimere without special features, much as in *communis* and *macdonaldi*; apex of basimere with tuft of dark, flattened, twisted setae as in *greenii* and its allies; subapical lobe with 2 spines; appendage to harpago more or less falciform; proximal claspette with tuft of very long setae and 2 tufts of shorter, spiculate setae; paraprocts long, slender, attenuated as in *macdonaldi*; IXth tergite with 2 separate lobes, one with 3, the other with 4 setae; IXth sternum rather elongated with narrow, well defined median lobe.

PUPA. *Cephalothorax.* Seta 6-C shorter than 7-C, single; 7-C bifid or trifid. *Abdomen.* Seta 1-II with 2-4 primary branches, 1 or 2 of them with secondary branching; 5-II short, slender; 9-II-VI minute; 5-IV and 5-V single, about as long as the following segment; 5-VI much shorter, single or bifid; 9-VII single or bifid; 9-VIII single to tetrafid. *Paddle.* Fringe long though relatively scanty; male genital sac with apical horns relatively broad and blunt; seta 1-P single.

LARVA. *Head.* Antenna slender, curved, lightly spiculate, pigmented distally; seta 1-A with 2-3 plumose branches; inner mouthbrush setae slender, simple (occasionally strongly pectinate according to Lien 1968); seta 5-C with 9-10 branches; 6-C with 2-3 branches, one longer and stouter than the other(s). *Abdomen.* Comb a patch of 14-17 uniformly fringed scales; siphon about 4-5 times as long as saddle with seta 1-S long, bifid or trifid, arising just beyond the terminal pecten tooth; pecten with 6-10 large teeth, each with 1 or more well developed secondary denticles; saddle with apex finely spiculate; seta 1-X bifid or trifid, 2-X bifid or trifid, 3-X single; ventral brush with 8 setae, all or all but 2 of them in the barred area and all single or bifid; anal papillae very long, broad, bluntly rounded at apex.

TYPE DATA. Holotype male and allotype female, with associated larval and pupal skins, in Taiwan Provincial Malaria Research Institute, Taipei; type locality: Kuantzulin, Paiho Township, *Tainan*, TAIWAN.

DISTRIBUTION. Specimens examined: 1 male and 1 female paratypes, with associated larval and pupal skins, from type locality. *Other Distribution*. Said to be widely distributed, but rare, in the whole of TAIWAN south of latitude 24°40'N.

TAXONOMIC DISCUSSION. This species is clearly related to *greenii*, from southern India and Ceylon, and to its allies *lii*, from China and Korea, and *kanhsiensis* from China. *H. lii* differs in having numerous very broad, leaf-like setae at the apex of the basimere and both this and *greenii* (and, apparently *kanhsiensis*) differ in the appendage to the harpago. *H. greenii* has a small pale spot below at the base of the proboscis. *H. lii* has the proboscis all dark. The present species also resembles *communis* and *macdonaldi* which share with it, and with the *greenii* group, the double spine on the subapical lobe of the basimere. Finally the spiculate setae on the proximal claspette furnish an interesting link with *achaetae* and subgenus *Mattinglyia*.

The curious mid tarsal claw of the male may be an aberration. It is shown by both available specimens but these may have come from the same egg batch. In *lii* both mid tarsal claws are simple and nearly straight. In *greenii* each has 2 delicate teeth arising near the base.

BIOLOGY. Breeding places are said to include bamboo stumps and tree holes below 1000 m. Adults are said to bite man during the daytime in forest (Lien 1968).

SUBGENUS *MATTINGLYIA* LIEN

Mattinglyia Lien 1968, Trop. Med., Nagasaki, 10: 128. Type species: *Mattinglyia catesi* Lien.

This was erected by Lien (1968) as a distinct genus. However, *thelmae* n. sp. (p. 48) shows so many annectent characters that subgeneric status is clearly more appropriate. The principle subgeneric characters are as follows:

FEMALE. Anterior pronotal lobes well separated; lower mesepimeral bristle present (except in *catesi*); scutellum with broad, silvery scales on mid lobe; postnotal bristles and scales absent; fore and mid tarsal claws toothed (except in *thelmae*); lateral plates of IXth tergite fused (except in *thelmae*).

MALE. (Unknown in *thelmae*). Antenna strongly plumose; distimere relatively simple; subapical lobe of basimere inapparent, the spine or spines normally associated with it apparently represented by 2 flattened leaf-like structures with expanded apices; one lobe of proximal claspette with a fan-like array of flattened blades, the other with recurved setae.

HEIZMANNIA (MATTINGLYIA) ACHAETAE (LEICESTER)
(Figs. 1, ♂; 44, ♀; 45, ♂♀ terminalia, ♂ claws; 46, pupa, larva)

Dendromyia achaetae Leicester 1908, Cul. Malaya, 257 (♀).

Heizmannia stonei Mattingly, Thurman 1959, Univ. Maryland Agr. Expt. Sta. Bull. A-100: 72 (misidentification).

Resembles *catesi* but differing in the characters given in the keys.

FEMALE. *Head.* Top of head with broad, dark scales and a patch of silvery scales on either side; a patch of broad, silvery scales on vertex; eyes widely separated behind; tori almost touching; basal joint of antennal flagellum with small, dark scales; proboscis moderately stout, somewhat swollen before tip, exceeding the length of the fore femur by a little more than the length of the labellum; clypeus bare; palpus about one-sixth of the length of the proboscis or a little less. *Thorax.* Scutal scales usually with golden and reddish purple reflections, occasionally appearing mainly green; prescutellar bristles absent; mid lobe of scutellum with broad, silvery scales; anterior pronotal lobes smaller than usual with broad silvery scales; posterior pronotum largely or wholly covered with broad silvery scales; sternopleuron covered with silvery scales except for the prealar area and the anteroventral quadrant which are bare; mesepimeron with a similar patch covering most of the upper three-fourths but with the posterior border bare; postspiracular bristles absent; posterior border of sternopleuron with a single long, stout bristle; postnotum without scales or bristles. *Wing.* Plume scales on veins R_2 and R_3 broad; cell R_2 always less than 2.5 times as long as its stem, usually less than 2 times. *Legs.* Hind femur pale anteriorly and posteriorly on about the basal three-fifths or less, the dark dorsal stripe very narrow, sometimes incomplete; fore and mid tarsal claws each with a single small tooth. *Abdomen.* Tergum I dark; tergum II with a basal lateral patch of silvery scales, not prolonged posteriorly along ventral border; terga III-VII with similar basal lateral patches but narrower and prolonged inwards towards mid line; V-VII with continuous silvery basal bands, sometimes incomplete or, rarely, absent on V and VI; sternum VII dark; the other sterna with silvery basal bands. *Terminalia.* Cerci broader than usual; postatrial plates strongly sclerotized, each with a strongly spiculate area at its inner edge; IXth tergum a single broad bilobed plate.

MALE. *Head.* Antenna (Figure 1) with the 2 terminal joints elongated and with short hairs; remainder of flagellum strongly plumose; palpus as in female. *Legs.* Fore and mid tarsi with one claw toothed at base, the other with a smaller tooth at half way. *Terminalia.* Distimere slender, bent inwards through approximately 90 degrees, with a prominent flange and stout spiniform appendage; apex of basimere with a dense cluster of flattened, pointed, fimbriated setae; subapical lobe not developed, the stout spines which it bears in other species of the genus here represented by 2 thickened setae with apices expanded to form transparent leaflets; these leaflets appearing single in most preparations but seen to be double on rotation; inner tergal edge of

basimere with several closely packed rows of hooked setae; proximal claspette (*pcl*) bilobed, one lobe with numerous fine hairs becoming progressively shorter anteriorly, the other with broad, flattened setae; distal claspette (*dcl*) with 3-6 short, slightly flattened setae; harpago absent; paraproct slender, strongly sclerotized distally, expanded at base; Xth sternum membranous, pilose basally; aedeagus with lateral plates strongly toothed, rather loosely hinged and easily separated by pressure, their apices overlapping; IXth tergum smoothly concave, without lobes; IXth sternum sclerotized at sides and with a median sclerotized area bearing a group of stiff bristles.

PUPA. *Cephalothorax*. Seta 6-C long, relatively stout, single; 7-C shorter, more delicate, single to trifid. *Abdomen*. Seta 1-II very feebly developed, single to trifid; 5-II very small, slender, single; 9-II-VI minute; 5-IV single, of the same order of length as the following segments; 5-V-VI single, very short, markedly smaller than 6-VI; 9-VII with 3-5 and 9-VIII with 3-9, plumose branches. *Paddle*. About 1.6 - 1.8 times as long as broad, with multiple fringe of fine hairs and spicules; seta 1-P usually bifid, occasionally single or trifid; male genital sac more or less oblong with short apical horns.

LARVA. *Head*. Antenna short, cylindrical, devoid of spicules or almost so; seta 1-A single, simple; mouthbrush setae all very short, the inner ones stout and strongly pectinate; seta 5-C with 6-9 branches; 6-C with 2-3 slender, more or less equal, non-plumose branches. *Abdomen*. Comb of 5-13 small, sharp-pointed spines (*cs*), delicately fringed at base, in 1-2 irregular rows; siphon about 4 times as long as saddle (about 2.5 times as long as its breadth at base); pecten of 1-4 very small teeth (*pt*), each with a large denticle and some smaller denticles at base; seta 1-S bifid, about 1.5 times the diameter of the siphon at point of attachment, arising before half way, just beyond the distal pecten tooth; saddle with distal edge smooth; seta 1-X long, stout, plumose, with 1-4 branches; 2-X with 2-4 branches; 3-X single or bifid; anal papillae broad, bluntly rounded, about 4 times as long as the saddle; ventral brush with 8 setae arising from a barred area; these setae mostly trifid, one or 2 sometimes with 4-5 branches, the 2 shortest often bifid.

TYPE DATA. Holotype female, on pin, in British Museum; type locality: Jungle patch, 5th mile, Gombak Road, Kuala Lumpur, *Selangor*, WEST MALAYSIA.

DISTRIBUTION. Specimens examined: THAILAND, *Chiang Mai*, Tad Muang Waterfall 1 male with pupal skin and 2 larval skins, Doi Suthep 1 female; *Nakhon Si Thammarat*, Khao Kaeo Banna 4 females, Khao Luang Banna 2 females, *Songkhla* (Boriphat Waterfall) 1 female; *Chumphon*, Ranong (Kra Buri) 1 female; *Nakhon Ratchasima*, Korat (Pak Chong) 2 females; *Trat*, Ko Chang I. 1 female. WEST MALAYSIA, *Selangor*, Kuala Lumpur (15th and 16th miles, Gombak Road) 6 males, 16 females, 10 pupal and 10 larval skins, (5th mile, Gombak Road) 1 female, (Ampang Reserve) 1 female; *Pahang*, Sabai 1 female; *Trengganu*, Gunong Tebu 1 female. EAST MALAYSIA, *Sabah*, near Kalabakan 1 male. INDONESIA, *Celebes*, Lambarese 1 female. *Other Distribution*. Recorded by Causey (1937) from Bon Pin, THAILAND.

TAXONOMIC DISCUSSION. This species was previously known only from the adult female. It was placed in the sabethine genus *Dendromyia* by Leicester, transferred to *Haemagogus* by Edwards (1922, 1932) and transferred again, to the present genus, by Mattingly (1957), who noted the resemblance to *Aedes kanarensis* Edwards. The latter was subsequently placed in *Aedes* subgenus *Diceromyia* (Mattingly 1959, 1965). Several characters of the newly discovered male terminalia confirm the affinity of *achaetae* with *Diceromyia*, especially the concentration of modified setae along the inner border of the coxite and the large group of flattened setae at the apex (shared with *Haemagogus* and some *Finlaya*). Other characters (structure of proximal claspette, 'streamlining' of style) recall Group A of *Stegomyia* with which *Ae. kanarensis* also shows affinities. It may not be without significance that the groups mentioned include all the known, and most of the suspected, vectors of yellow fever. A fuller understanding of relationships must, however, await the discovery of the males and early stages of other little known annectent species (*Ae. discrepans* Edwards, *Ae. tripunctatus* Theobald, *Ae. platylepidus* Knight & Hull). The aedine features of the male terminalia are not sufficiently pronounced to justify the removal of *achaetae* from *Heizmannia* and the characters of the early stages are fully consistent with its retention in this genus, particularly having regard to the annectent character of *thelmae* n. sp.

The male and early stages described by Thurman (1959) under *stonei* belong, in fact, to the present species.

BIOLOGY. The Thailand larvae came from a tree hole and, in one case, from a fallen coconut leaf. Those from Malaya were raised from eggs laid in the laboratory. Adults have been taken on man in forest.

HEIZMANNIA (MATTINGLYIA) CATESI (LIEN)
(Figs. 47, ♀; 48, ♂♀ terminalia; 49, pupa, larva)

Mattinglyia catesi Lien 1968, Trop. Med., Nagasaki, 10: 130 (♂*, ♀*, P*, L*).

Resembles *achaetae*, differing in the characters given in the keys. The third member of the subgenus, *thelmae* n. sp., differs from both in various characters annectent to the previous subgenus.

FEMALE. *Head.* Top of head dark with large silvery lateral patches and a silvery median spot extending forward between eyes; eyes well separated; tori almost contiguous; basal joint of antennal flagellum dark scaled; proboscis long, slender, dark, about 1.2 times the length of the fore femur; palpus dark, about one-eighth of the length of the proboscis. *Thorax.* Scutal scales broad and flat with bright green, gold and reddish reflections; scutellum with a silvery spot on mid lobe, lateral lobes dark or with some silvery scales; postnotum bare; anterior pronotal lobes covered with silvery white scales; posterior pronotum with a small spot of silvery scales. *Wing.* Plume scales narrow; cell R_2 about 1.5 times as long as its stem. *Legs.* Hind femur entirely dark on about the distal half of both anterior and posterior surface, the

remainder pale except for a narrow dark dorsal stripe on most of the basal half; both fore and both mid tarsal claws toothed. *Abdomen*. Laterotergite with silvery white scales; terga II-VI with silvery white lateral patches at most slightly prolonged posteriorly along the ventral edge, prolonged well in towards mid line; one specimen with a continuous silvery basal band on V; tergum VII with a silvery basal band; sterna with narrow basal silvery bands. *Terminalia*. Postgenital plate not deeply indented; IXth tergum with 1 bristle on each lobe in the specimen examined.

MALE. *Head*. Antenna with the 2 terminal joints together about equal in length to the remainder; the other 11 joints strongly plumose. *Legs*. Fore and mid tarsal claws strongly toothed (fide Lien), the former much the larger. *Terminalia*. Much as in *achaetae* but with the 2 subapical leaflets differently shaped; flattened blades on proximal claspette only 7 in number, the fine hairs fewer, all of them slender and more or less equal in length; distal claspette with 1-2 slender setae; setae on inner face of basimere very strongly hooked, arising from a prominent lobe.

PUPA. Much as in *achaetae* except that setae 5-IV and 5-V are longer than the following segments while 5-VI is about two-thirds as long as segment VII. *Paddle*. Spiculate, distinctly broader than in *achaetae*, about 1.5 times as long as its greatest breadth.

LARVA. *Head*. Antenna short, straight, smooth; seta 1-A single; inner hairs of mouthbrushes slender, simple; seta 5-C with 10-11 branches; 6-C bifid. *Abdomen*. Comb with 15-20 sharply pointed teeth (*cs*), fringed at base; pecten of 4-5 teeth (*pt*), each denticulate on both sides; seta 1-S trifid or tetrafid; seta 1-X bifid; 2-X tetrafid; 3-X single; anal papillae about 5 times as long as saddle, bluntly rounded at tips; ventral brush with 8 bifid or trifid setae.

TYPE DATA. Holotype male and allotype female, with associated larval and pupal skins, in Taiwan Provincial Malaria Research Institute, Taipei; type locality: Yuehmei, Sanlin, *Kaohsiung*, TAIWAN.

DISTRIBUTION. Specimens examined: TAIWAN, holotype male; *Pingtung*, Taiwu, Mashihshih 3 paratype females. *Other Distribution*. Recorded by Lien (1968) from the type locality and Mashihshih only.

TAXONOMIC DISCUSSION. Although closely related to *achaetae* this species is clearly distinct on the characters of the male terminalia and pupa. In one specimen seen by me the median silver spot on the occiput is completely fused with one of the lateral silver spots. There is thus a nearly complete silvery band on the occiput recalling the condition seen in *thelmae* n. sp. The complete, or almost complete, basal silver bands on the abdominal tergites also recall that species which differs, however, in important characters of the female terminalia and claws as well as the all dark anterior pronotal lobes.

BIOLOGY. The only known breeding places are bamboo stumps. Recorded as biting man viciously in the daytime.

HEIZMANNIA (MATTINGLYIA) THELMAE n. sp.
(Figs. 50, ♀; 38, ♀ terminalia, claws; 51, pupa, larva)

Differs from the other members of the subgenus in the all dark anterior pronotal lobes and from *achaetae* in the markings of the occiput and abdominal terga. It seems possible, however, that, as noted above, the present species and *catesi* may show overlapping variation in these characters.

FEMALE. *Head.* Top of head entirely covered anteriorly with broad flat, silvery white scales, broad dark scales behind; some small, dark upright scales on occiput; eyes close together except for a short distance behind; antenna with small pale scales on basal joint of flagellum; proboscis short and stout, somewhat swollen towards tip, about 0.8 times as long as fore femur; palpus nearly a quarter of the length of the proboscis. *Thorax.* Scutal scales broad with bright, mainly bluish, reflection and silvery highlights; prescutellar bristles absent; scutellum with a large spot of silvery scales at apex of mid lobe; anterior pronotal lobes and posterior pronotum entirely dark scaled; postspiracular bristles absent; postnotum bare. *Wing.* Plume scales on R₂ and R₃ relatively broad especially towards tip; anterior fork cell very long, about 3.3 times as long as its stem. *Legs.* Hind femur pale on about the basal two-thirds with very narrow dark dorsal stripe barely reaching to base; fore and mid tarsal claws simple. *Abdomen.* Tergum I dark; remaining terga with broad silvery basal bands, widening a little at sides on posterior segments; sterna not seen except VII which is dark. *Terminalia.* Cerci narrower than usual in the genus. Postatrial plates only lightly sclerotized. IXth tergum with 2 separate plates as in all other *Heizmannia* except *achaetae* and *catesi*. Spermatheca triple as usual.

MALE. Not known.

PUPA. *Cephalothorax.* Seta 6-C stouter, but shorter, than 7-C. *Abdomen.* Seta 1-II moderately stout, trifid; 5-II slender, single; 9-II-VI minute; 5-IV-VI single, shorter than the following segment; 9-VII small, single; 9-VIII bifid on one side, trifid on the other.

LARVA. *Head.* Antenna short, smooth, cylindrical; seta 1-A delicate, bifid; mouthbrush setae apparently non-pectinate; seta 5-C with 9-10 branches; 6-C single on one side, with 2 unequal branches on the other. *Abdomen.* Comb of 8 spines with stout median, and delicate lateral, denticles; siphon about 3 times as long as the saddle (3 times as long as its breadth at base); pecten of 2 very small teeth, simple or with minute denticles at base; seta 1-S missing; saddle edge smooth; seta 1-X long, single; 2-X bifid; 3-X single; all these simple; anal papillae short, blunt, cylindrical; ventral brush with 8 setae in barred area, all single or bifid.

TYPE DATA. Holotype female, on pin, with terminalia, claws and larval and pupal skins on slides, in the U. S. National Museum; type locality: Ban Chatri, *Ranong*, THAILAND. The species is named after Miss Thelma Ford in gratitude for her beautiful illustrations to this paper.

DISTRIBUTION. Known only from the holotype.

TAXONOMIC DISCUSSION. This species shares with the others in subgenus *Mattinglyia* the absence of scales or bristles from the postnotum.

It shares with subgenus *Heizmannia* s. str. the simple fore and mid tarsal claws of the female and the separate lateral plates of the female IXth tergum. It is thus annectent between the two subgenera though some striking resemblances in ornamentation, particularly to *catesi*, suggest that it is closer to *Mattinglyia*.

BIOLOGY. The only known specimen was bred from a bamboo.

ACKNOWLEDGEMENTS

The main sources of material for this paper have been collections made by the staff of the Medical Research Institute, Kuala Lumpur, in Malaya, and the SEATO Medical Research Laboratory, Bangkok, in Thailand, together with earlier collections in the U. S. National Museum and the British Museum (Natural History). For the Malayan material, and for data relating to it, I am greatly obliged to Dr. W. W. Macdonald of the Liverpool School of Tropical Medicine. Dr. J. C. Lien kindly supplied paratypes and one holotype of his new species and Dr. J. M. Klein of the Office de la Recherche Scientifique et Technique Outre-Mer sent material from Cambodia. Dr. Botha de Meillon and Dr. Alan Stone kindly made available to me the material from Thailand, now in the Southeast Asia Mosquito Project and the U. S. National Museum. I am also indebted to Dr. Stone and to Dr. de Meillon and his colleagues of the Southeast Asia Mosquito Project for much hospitality and assistance in Washington. The illustrations prepared by Miss T. L. Ford, Mr. Vichai Malikul and artists of the U. S. Army 406th General Medical Laboratory, Tokyo, speak for themselves.

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Fig.1

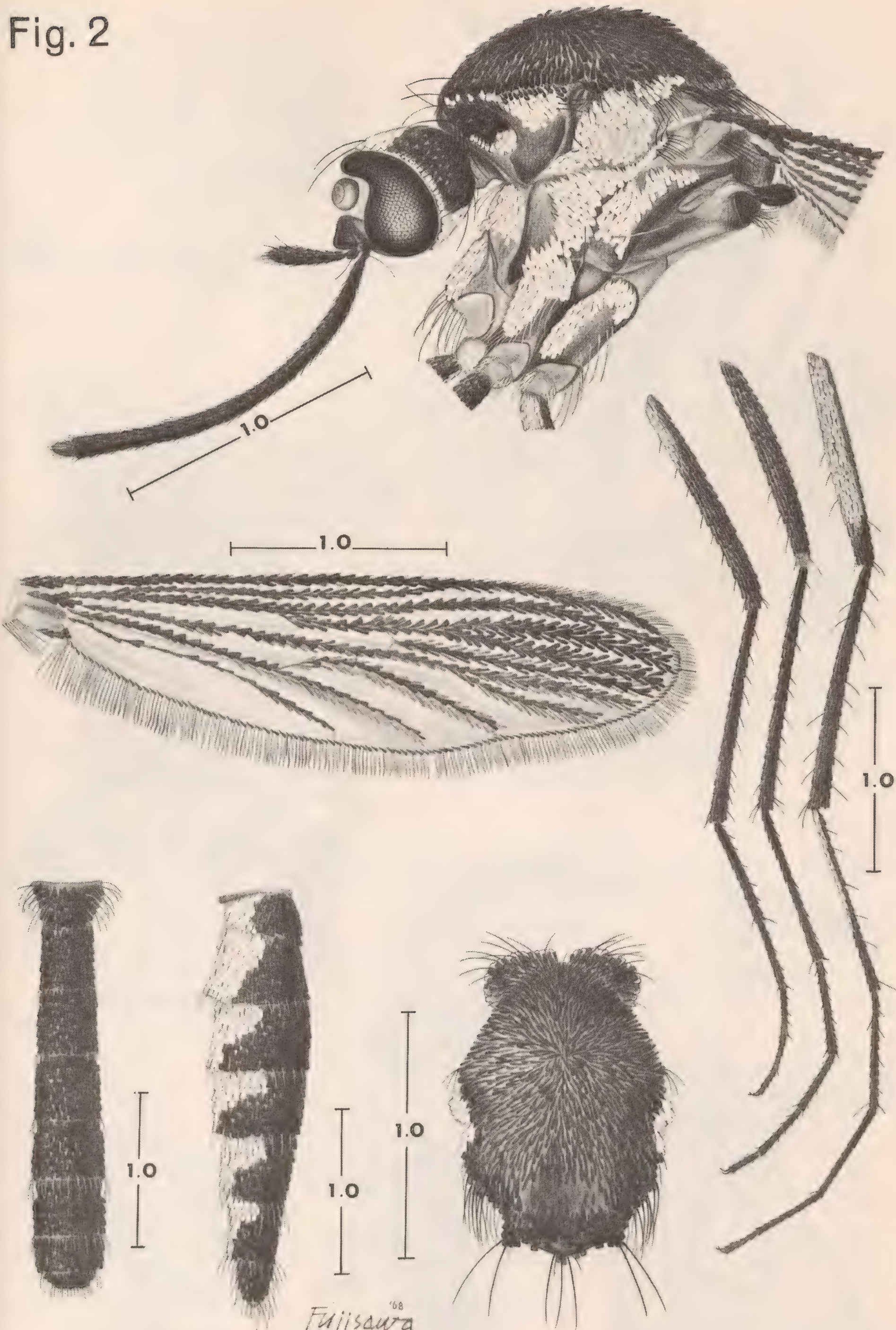


H. (Heizmannia) scintillans



H. (Mattinglyia) achaetae

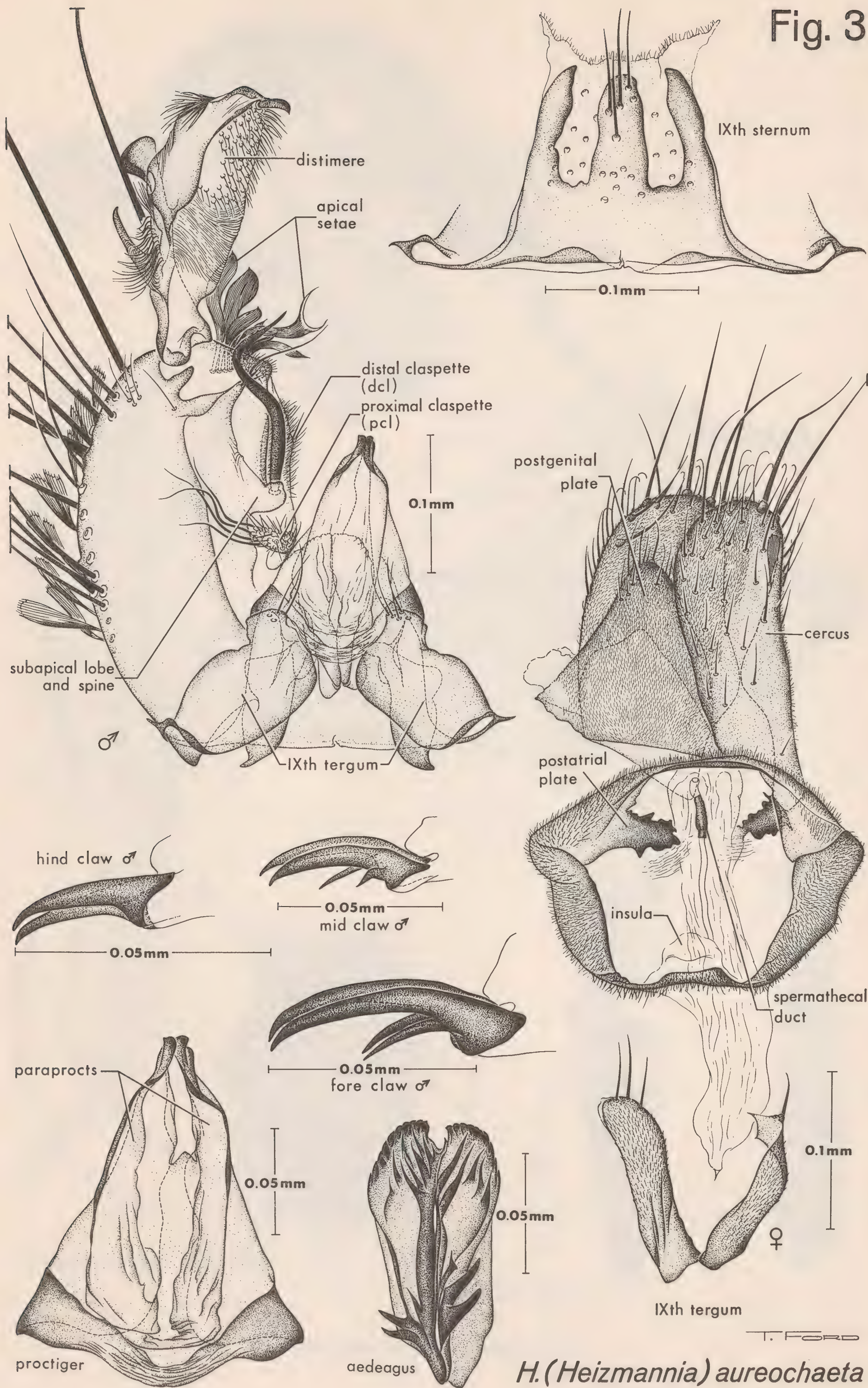
Fig. 2



⁶⁸
Fujisaura
Japan

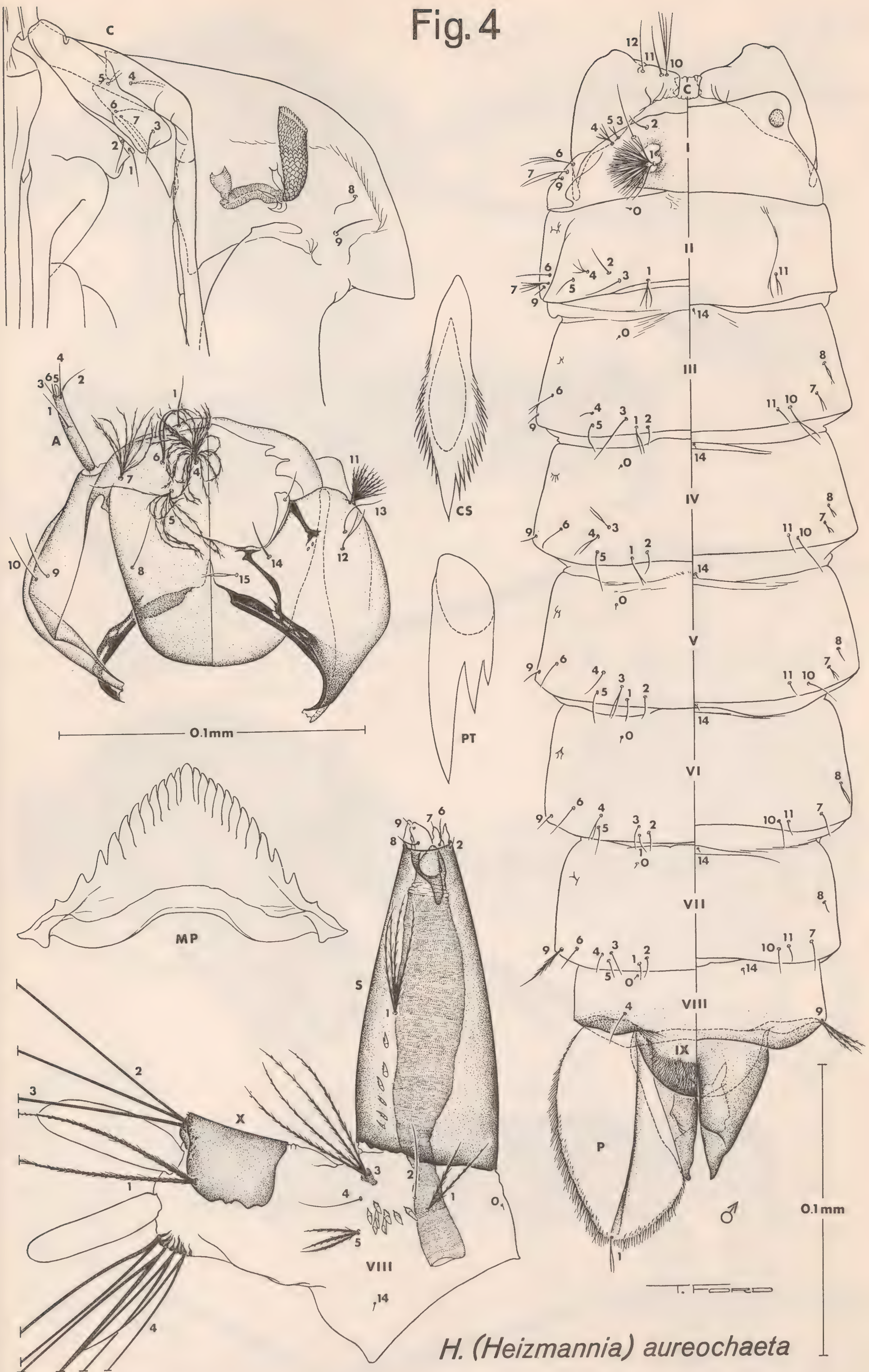
H. (Heizmannia) aureochaeta

Fig. 3



H. (Heizmannia) aureochaeta

Fig. 4



H. (Heizmannia) aureochaeta

Fig. 5

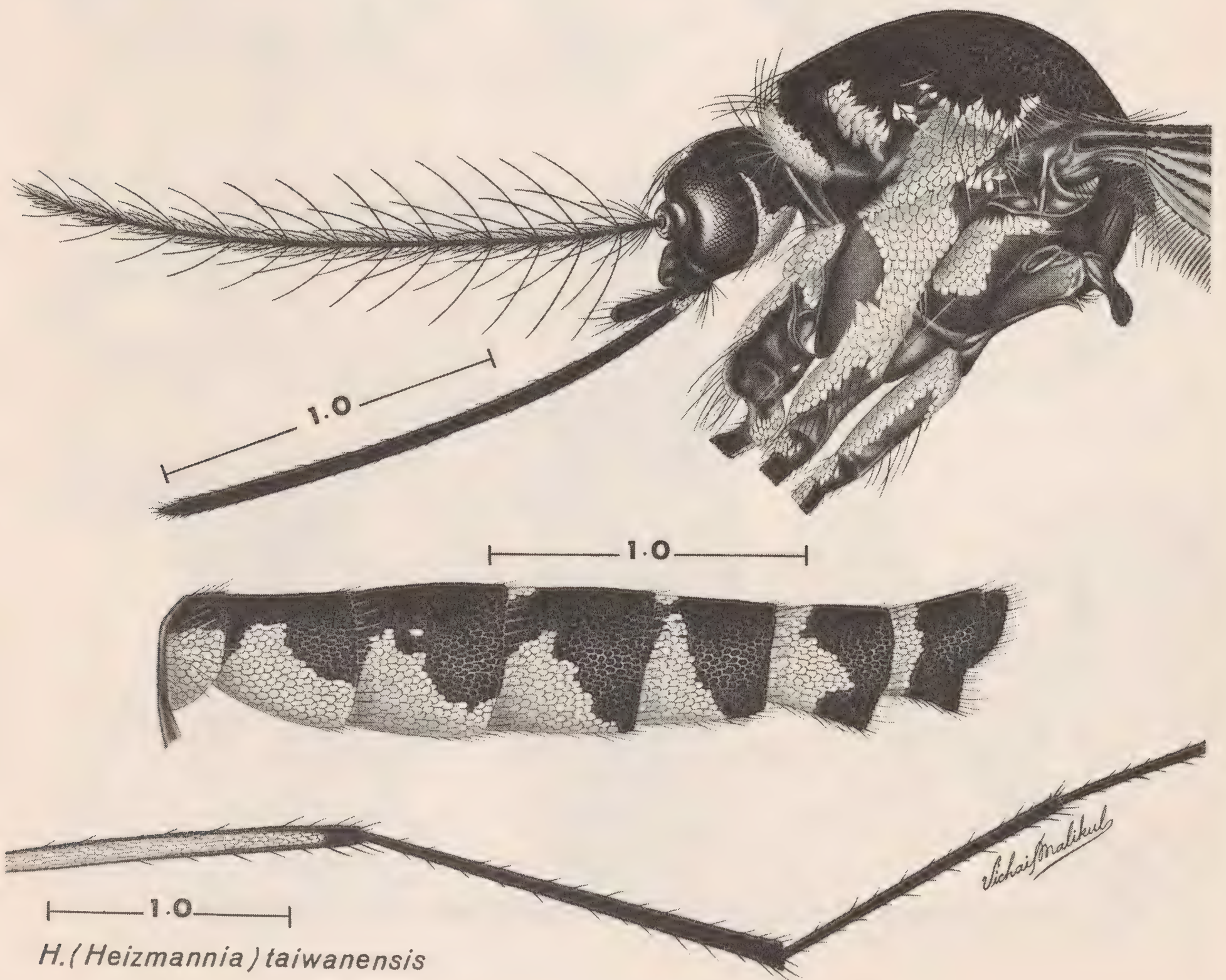
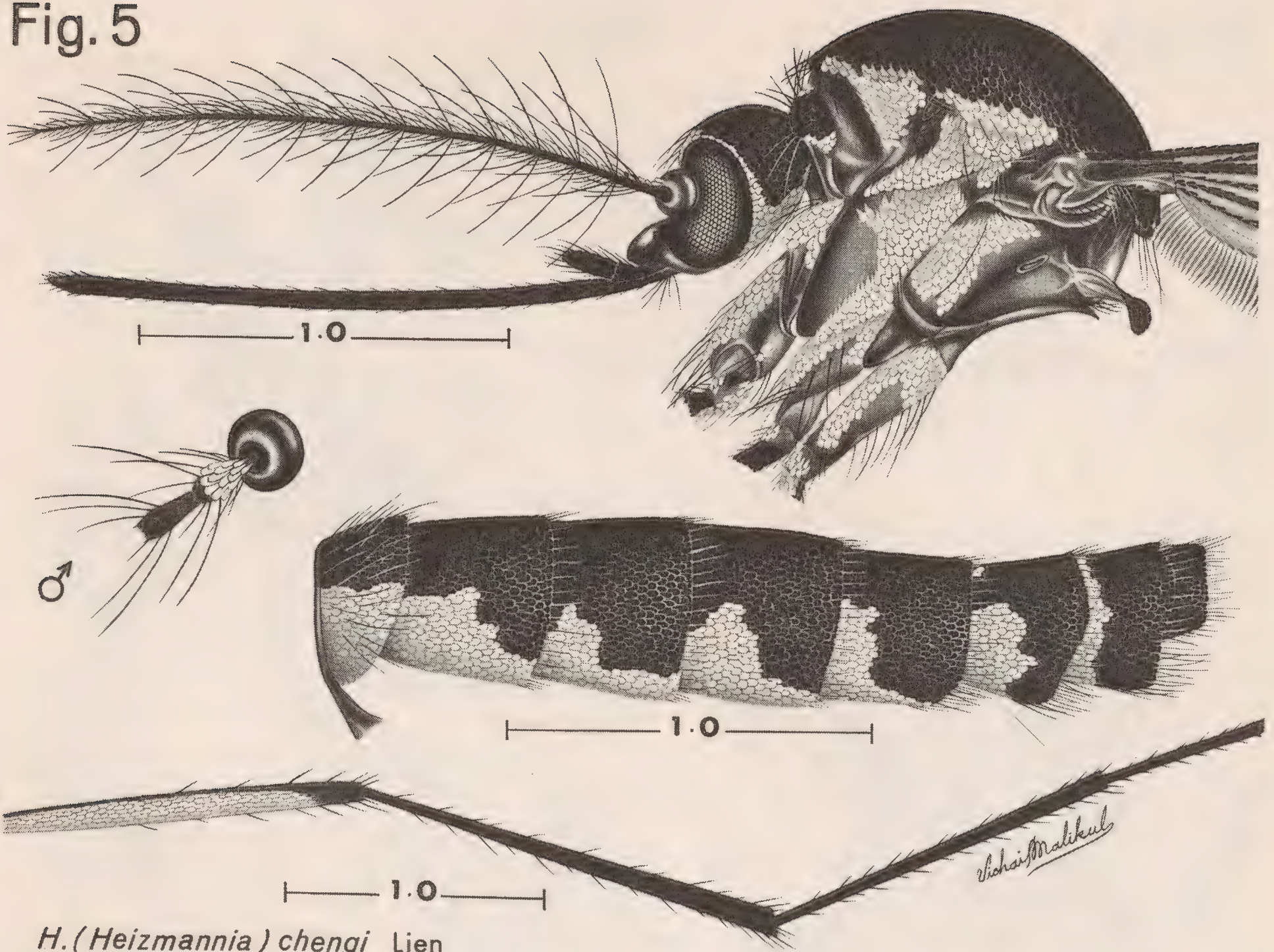
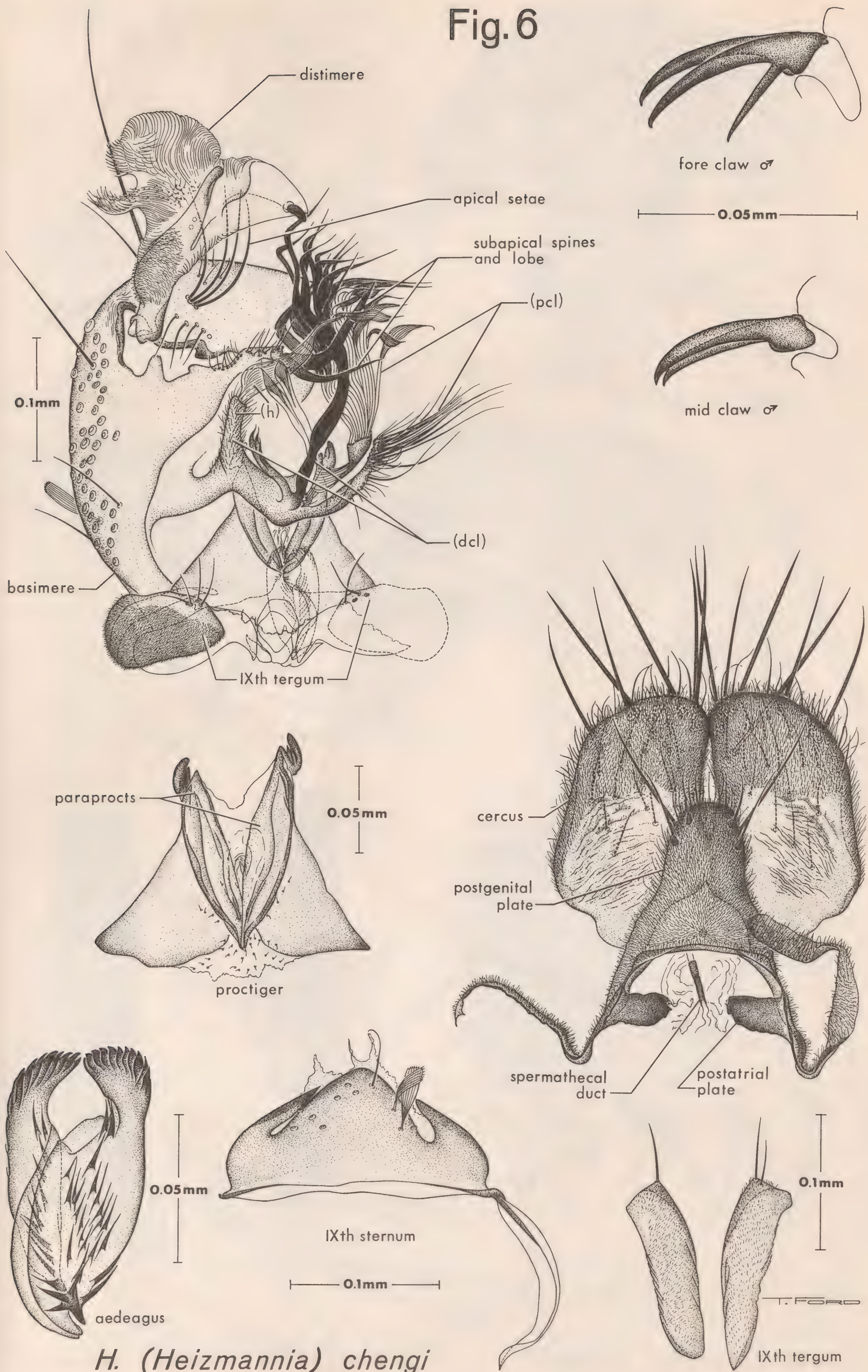
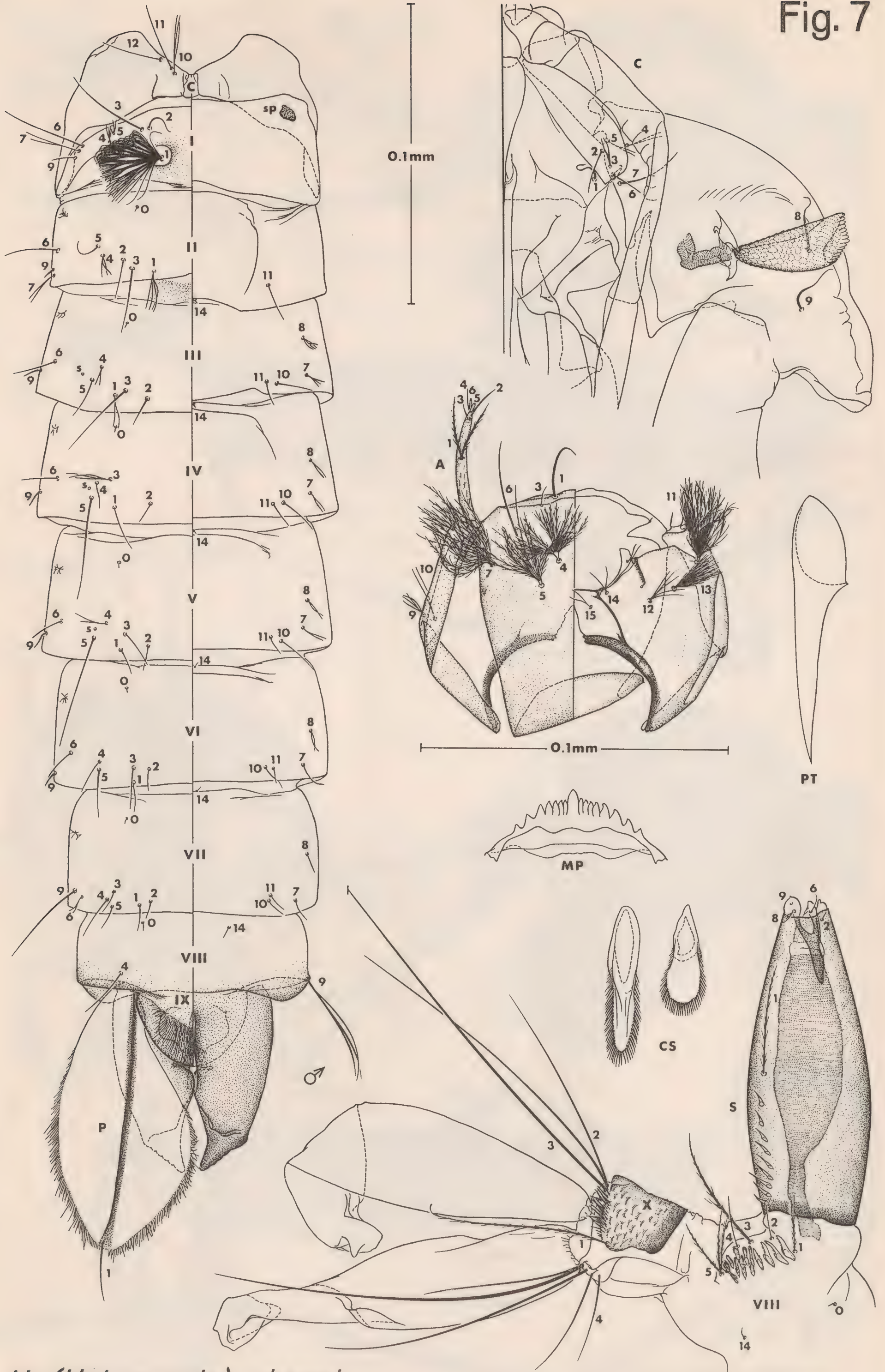


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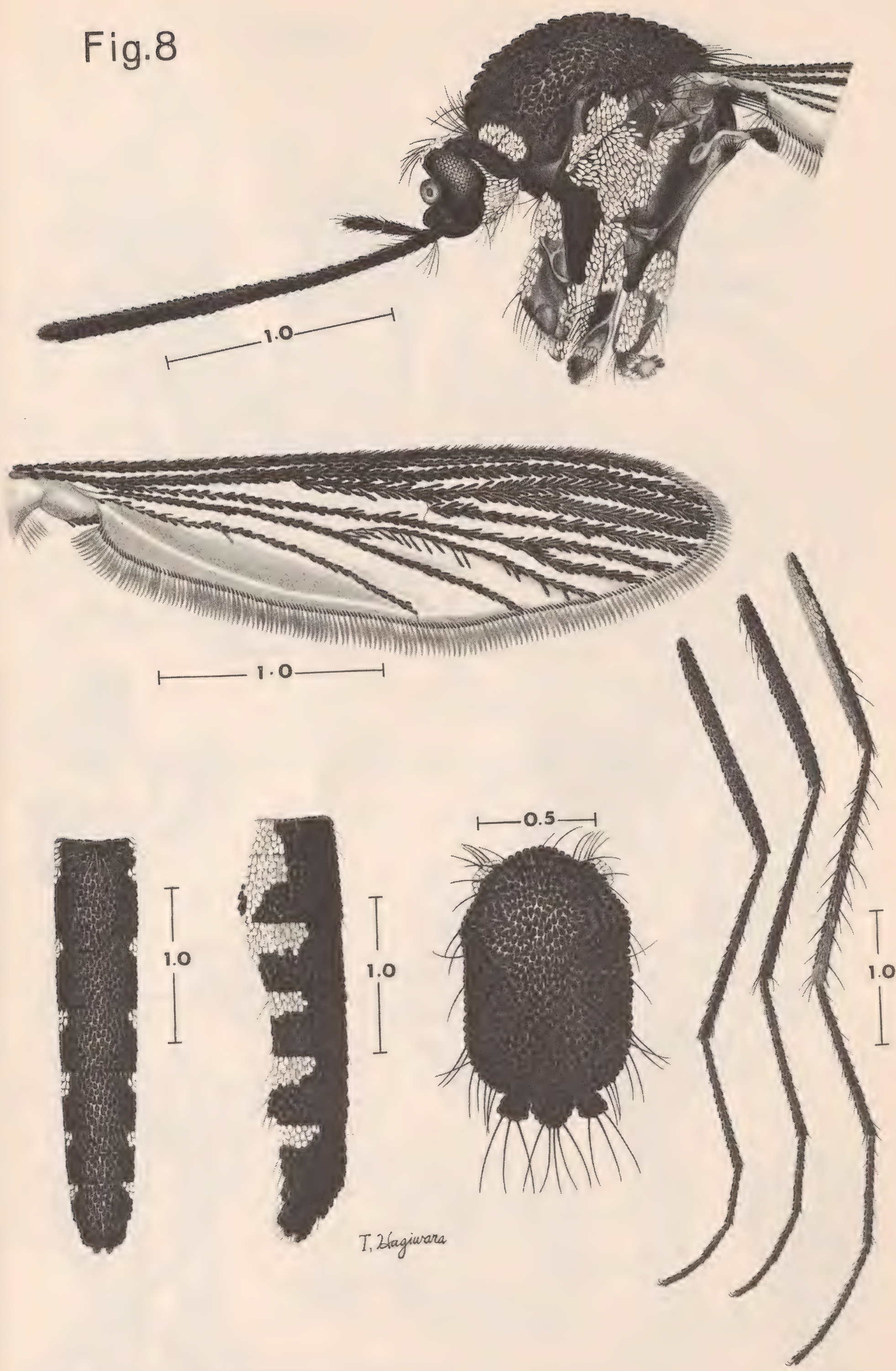
H. (Heizmannia) chengi

Fig. 7



H. (Heizmannia) chengi

Fig.8



H. (Heizmannia) communis

Fig.9

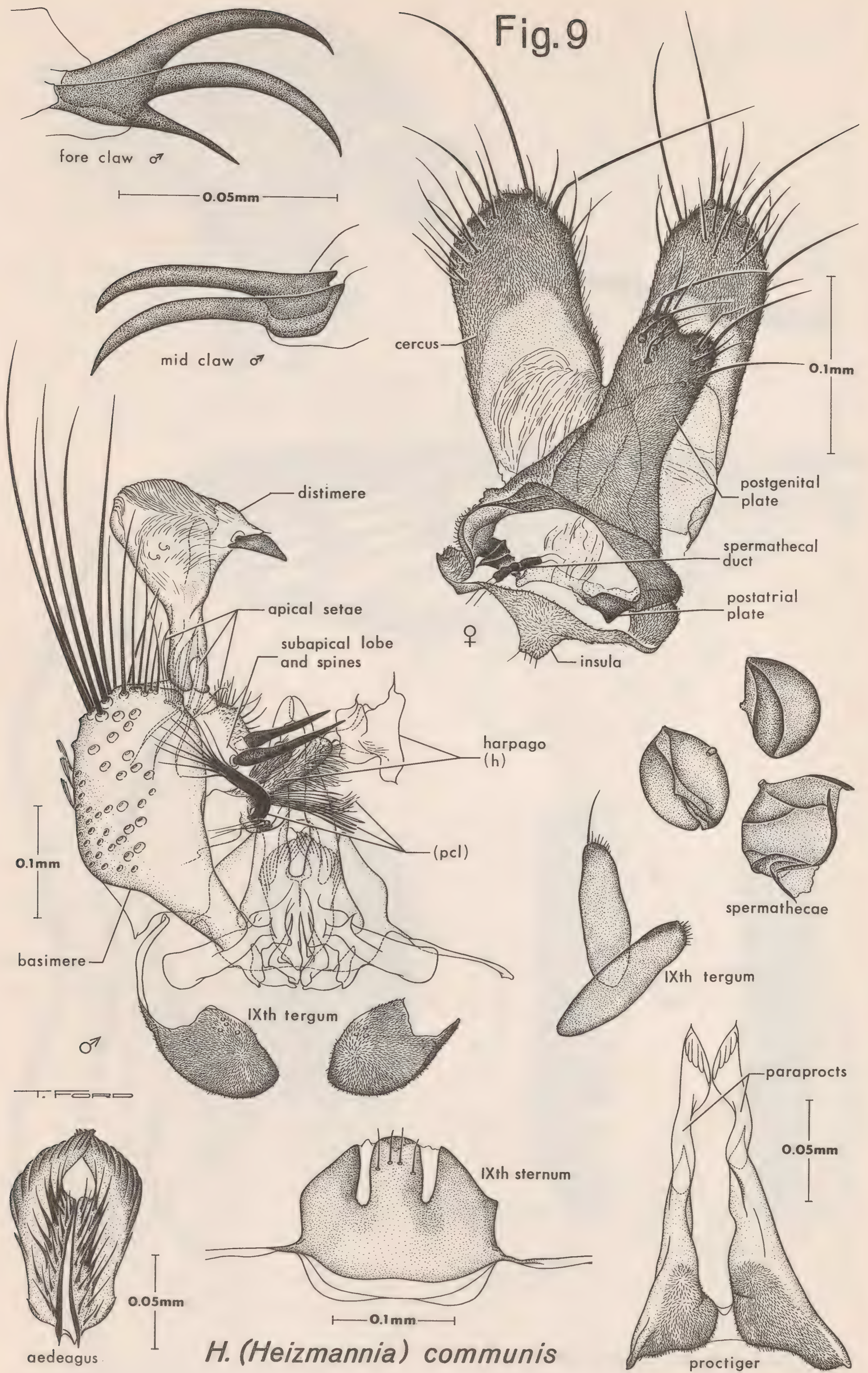
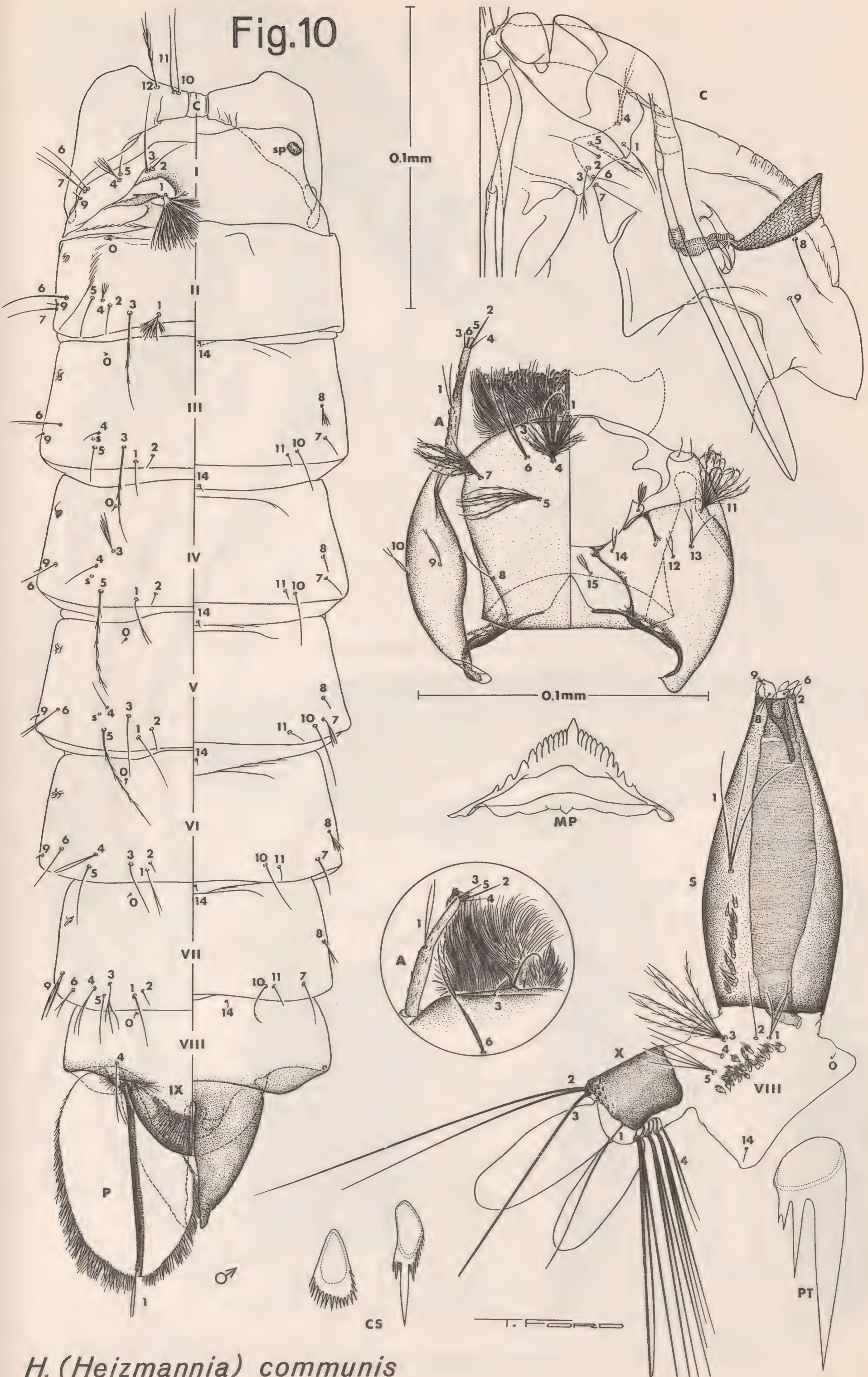


Fig.10



H. (Heizmannia) communis

Fig.11

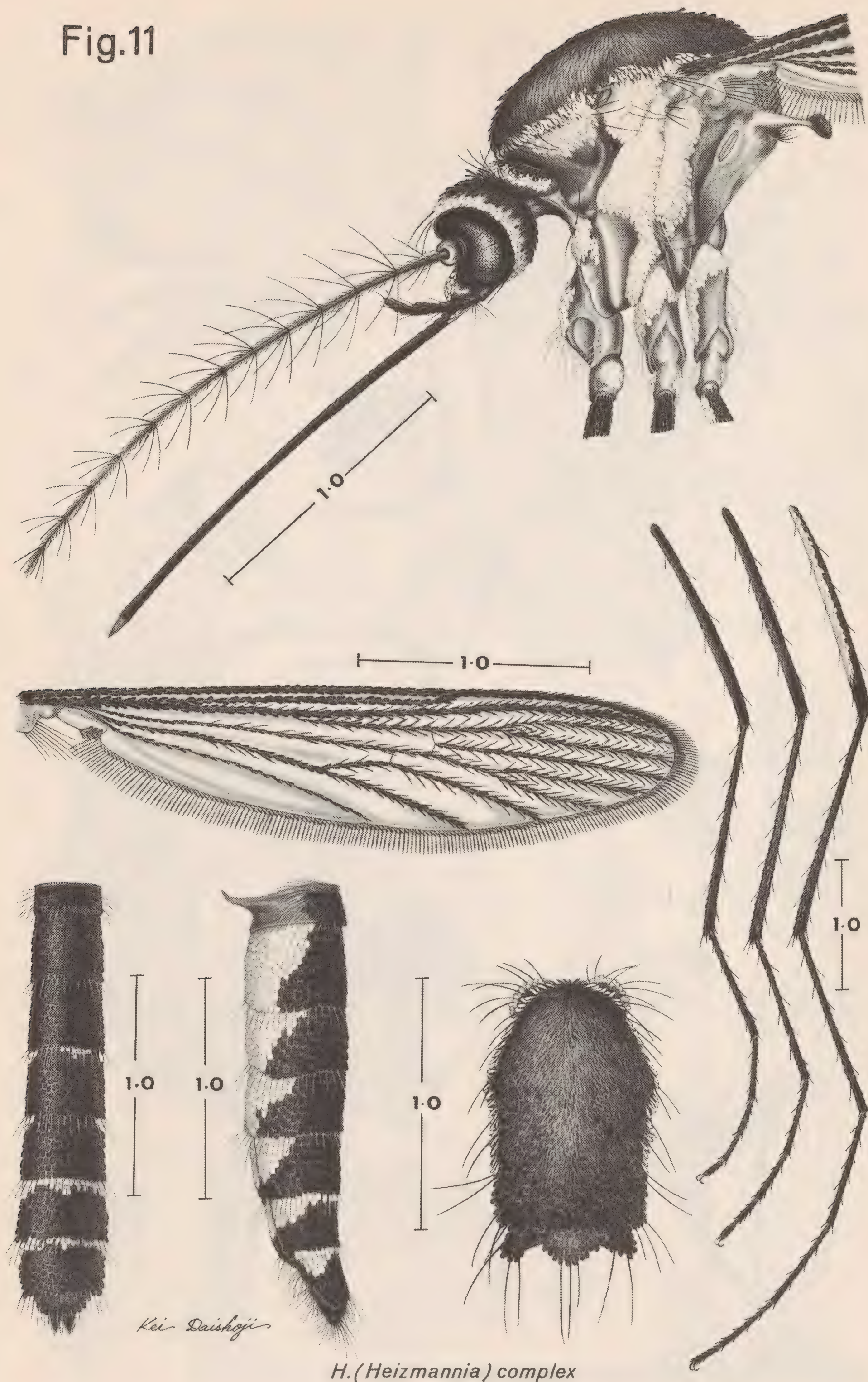
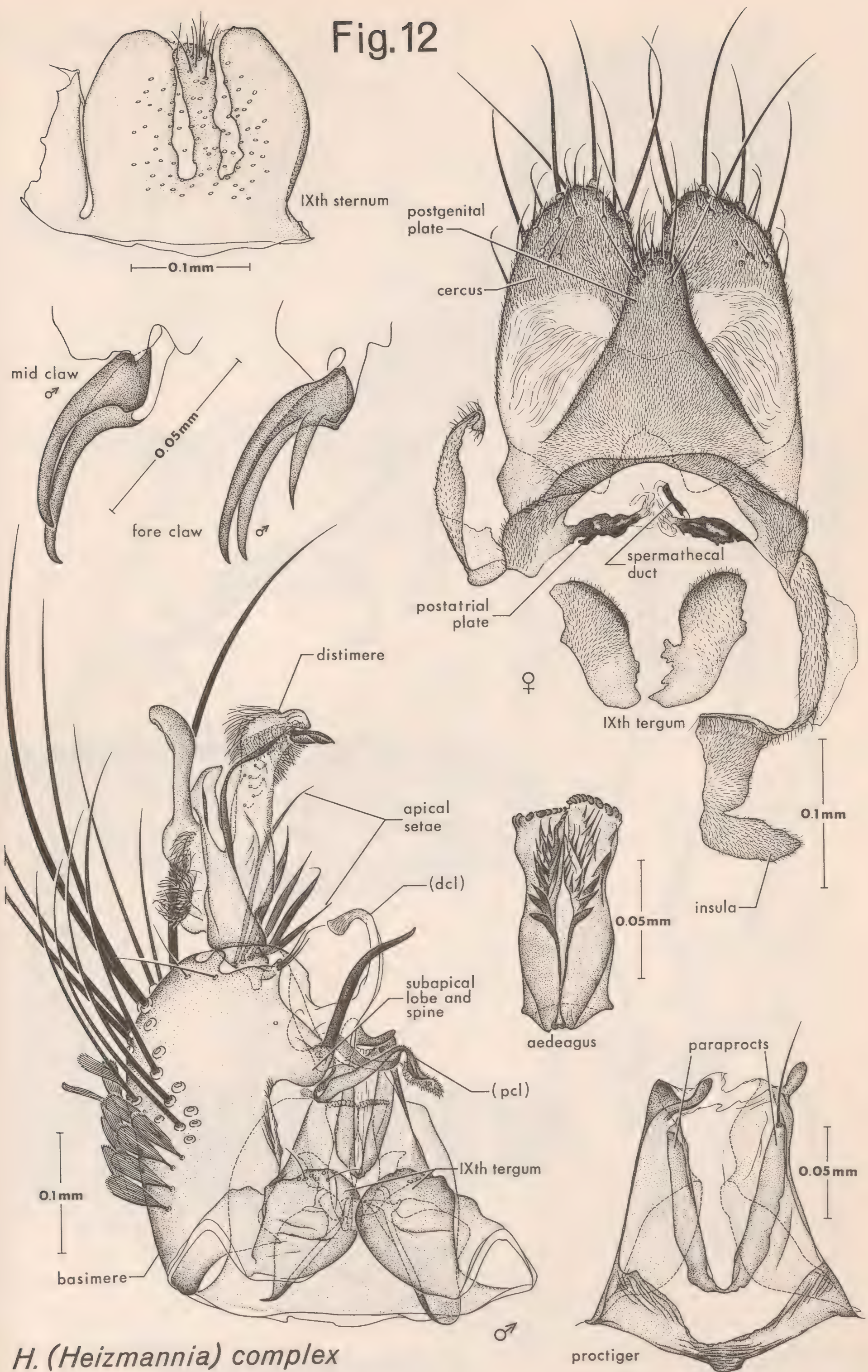
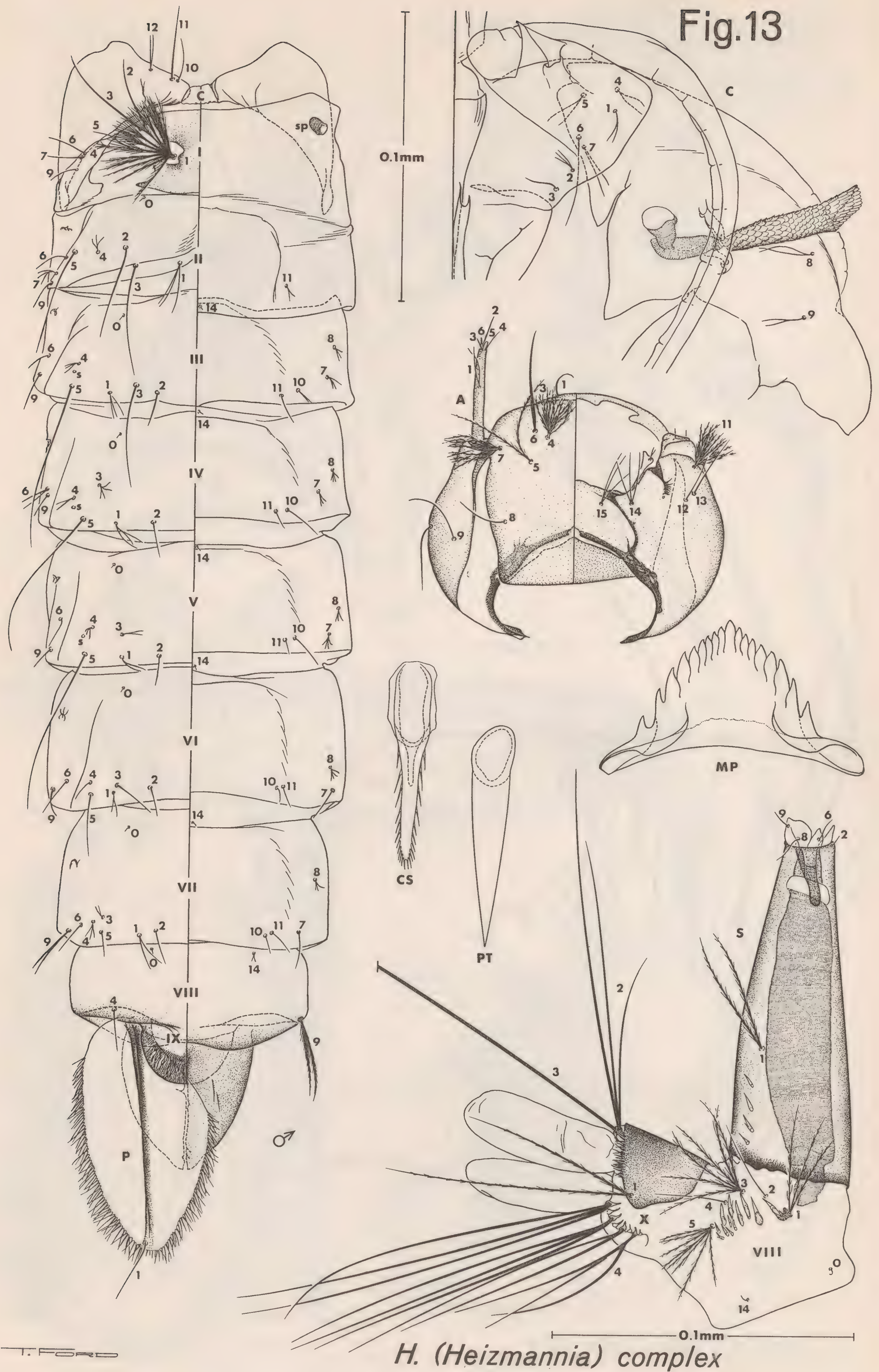


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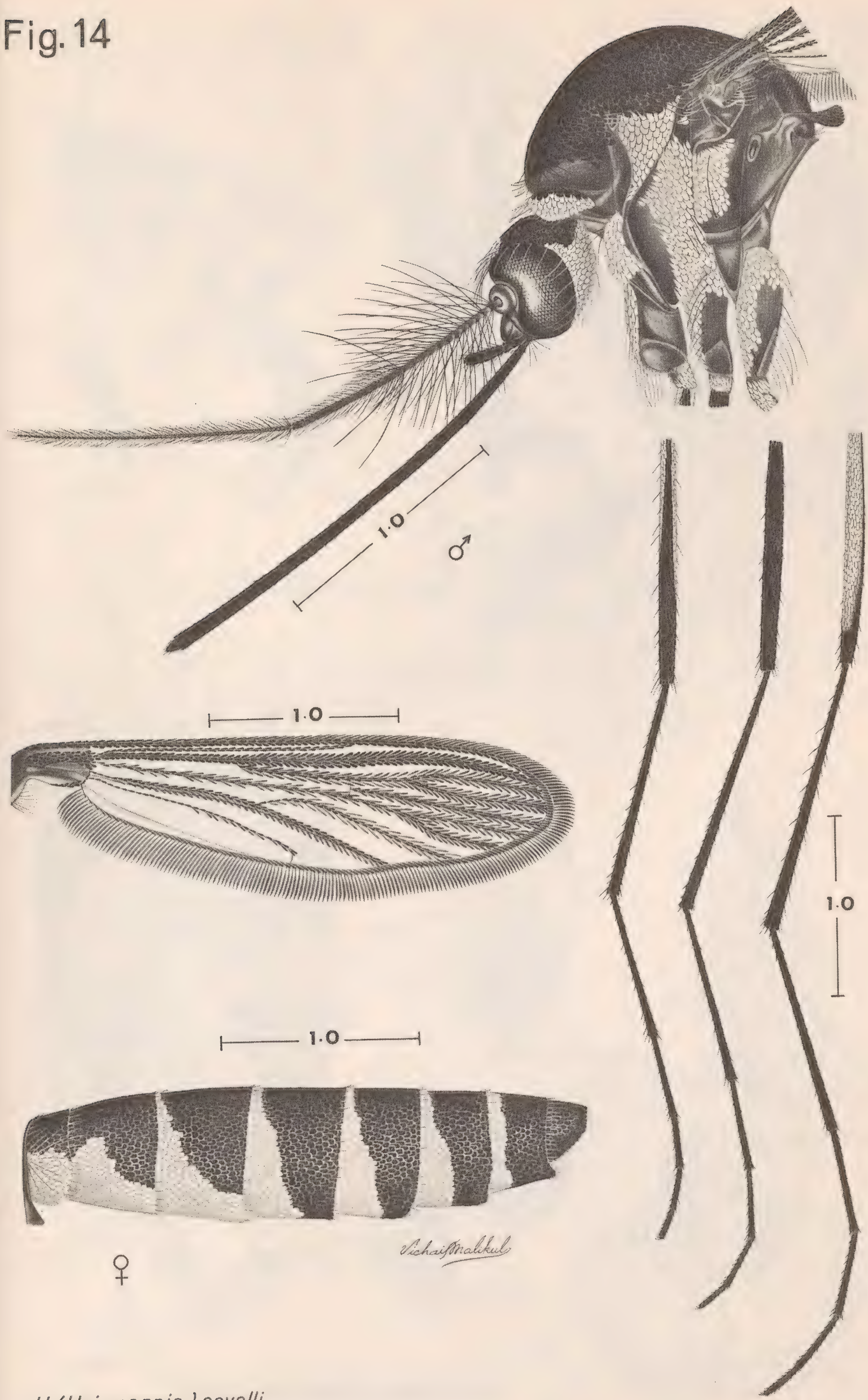
H. (Heizmannia) complex

Fig.13



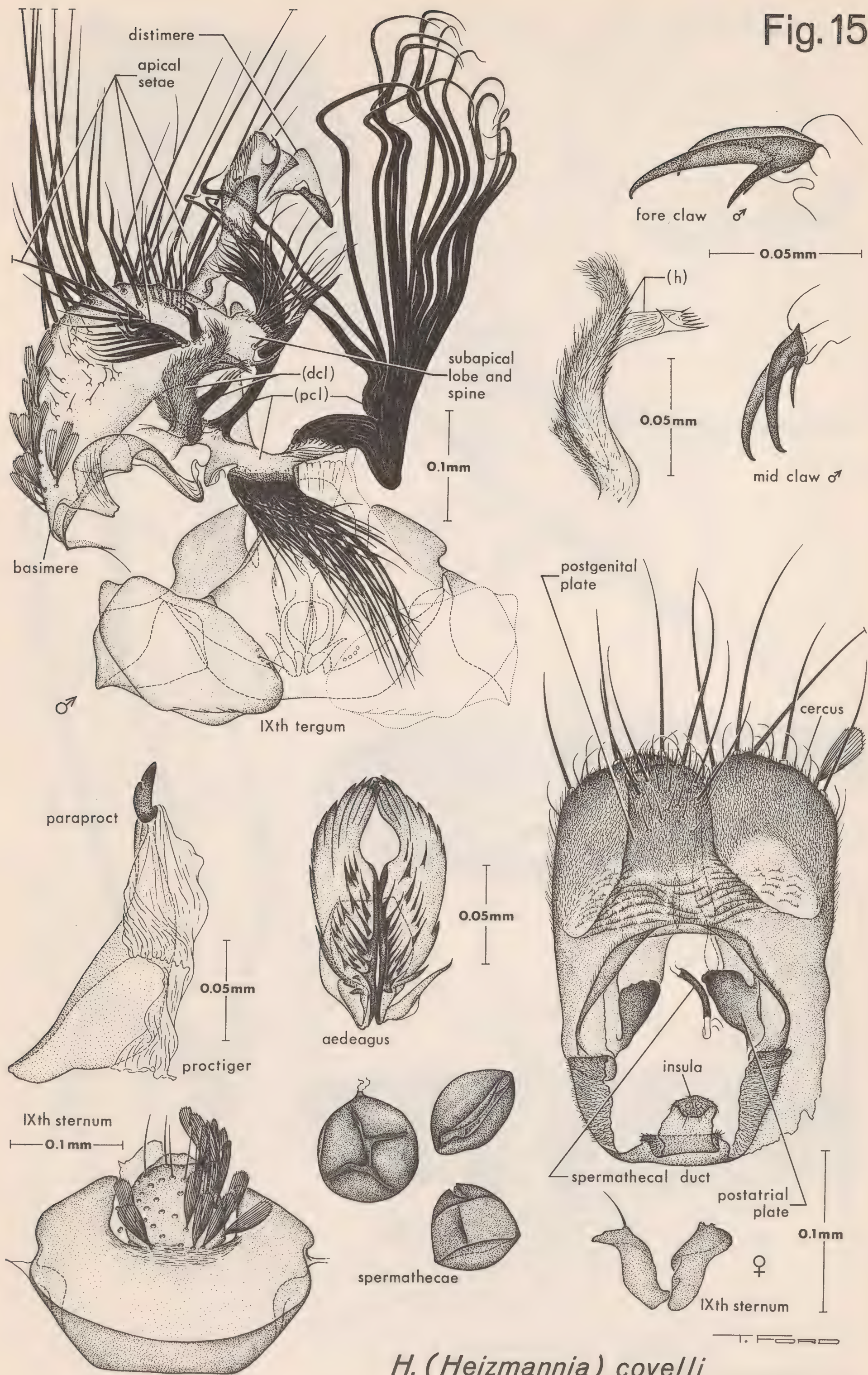
H. (Heizmannia) complex

Fig. 14



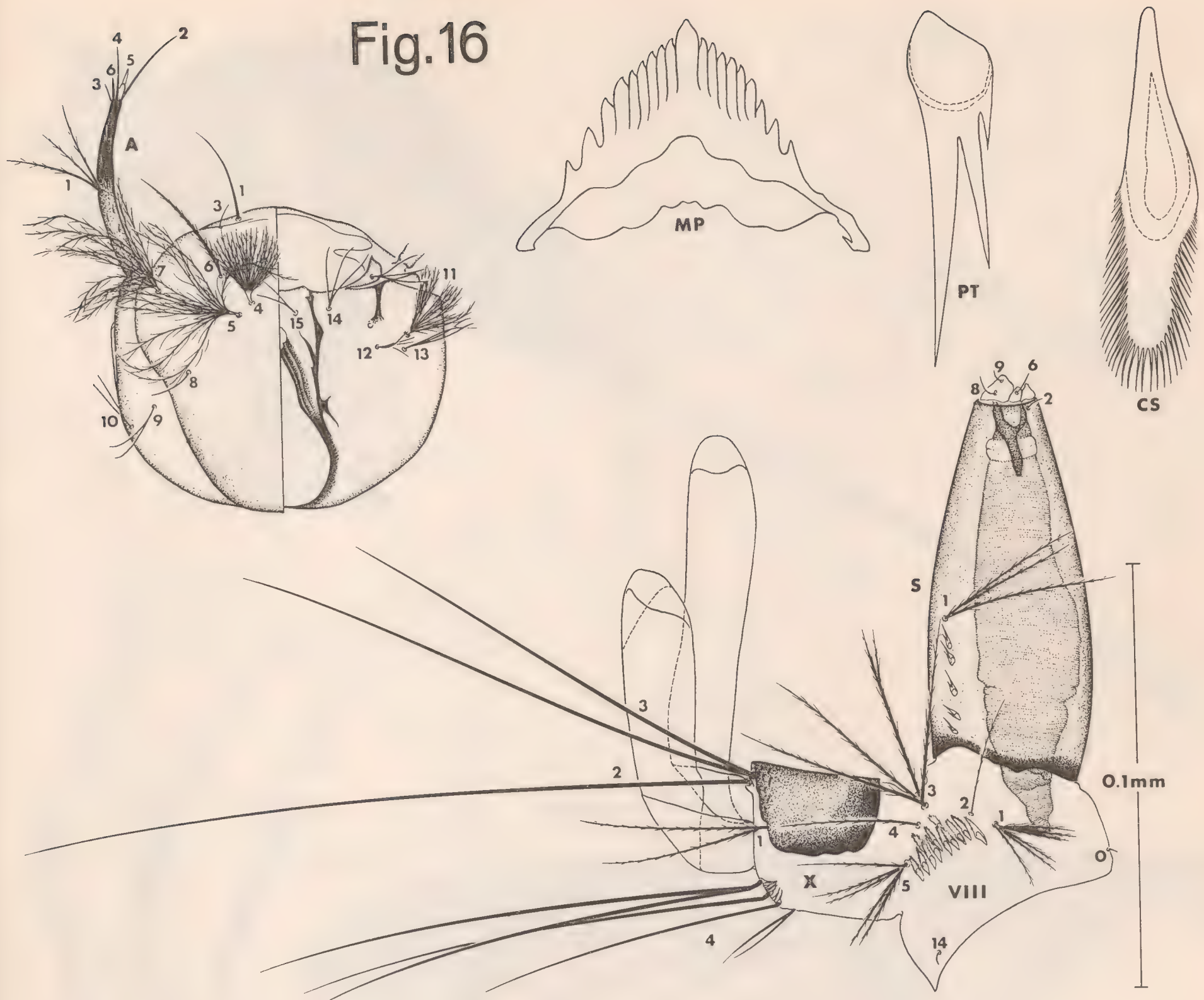
H. (Heizmannia) covelli

Fig. 15

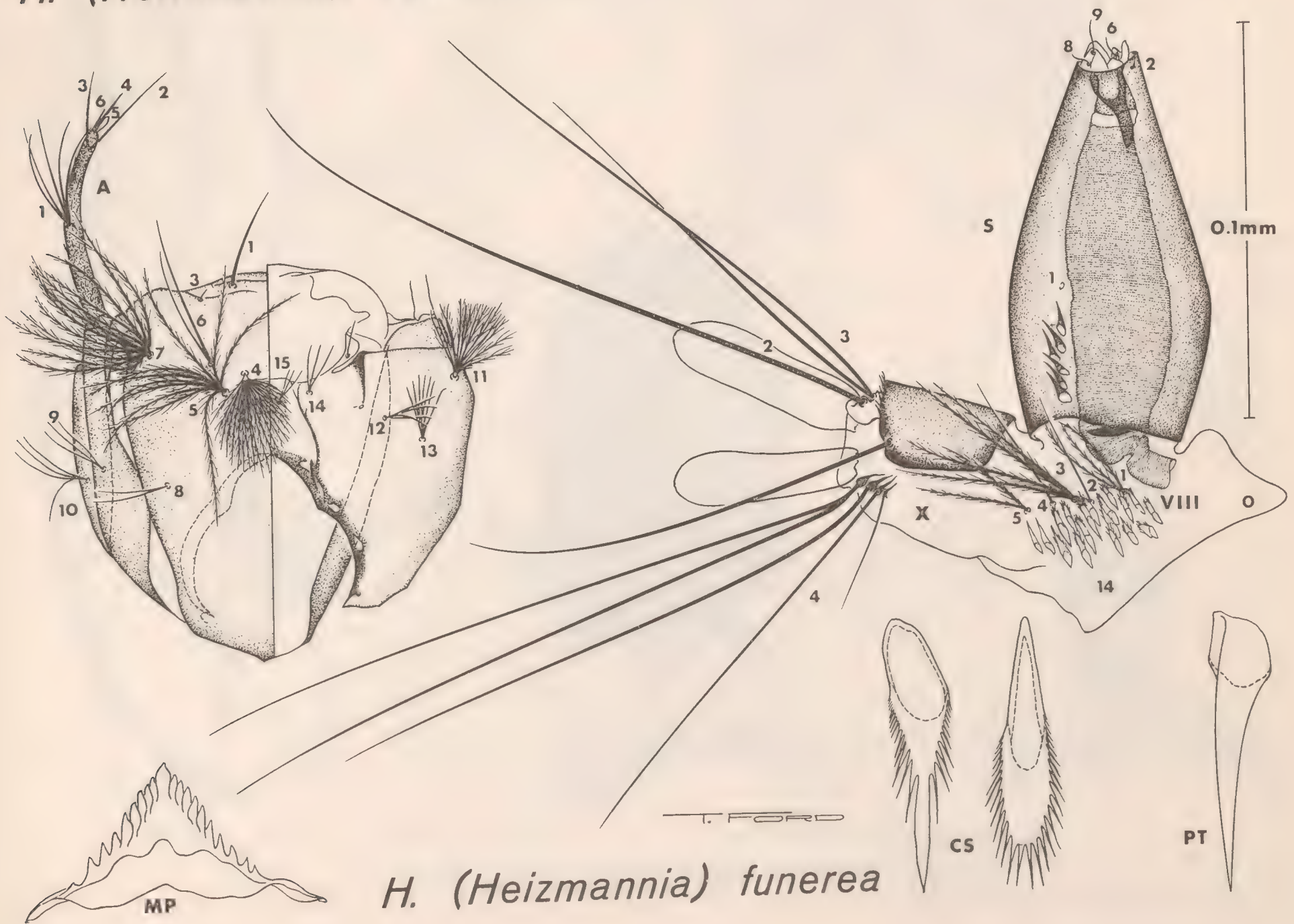


H. (Heizmannia) covelli

Fig.16

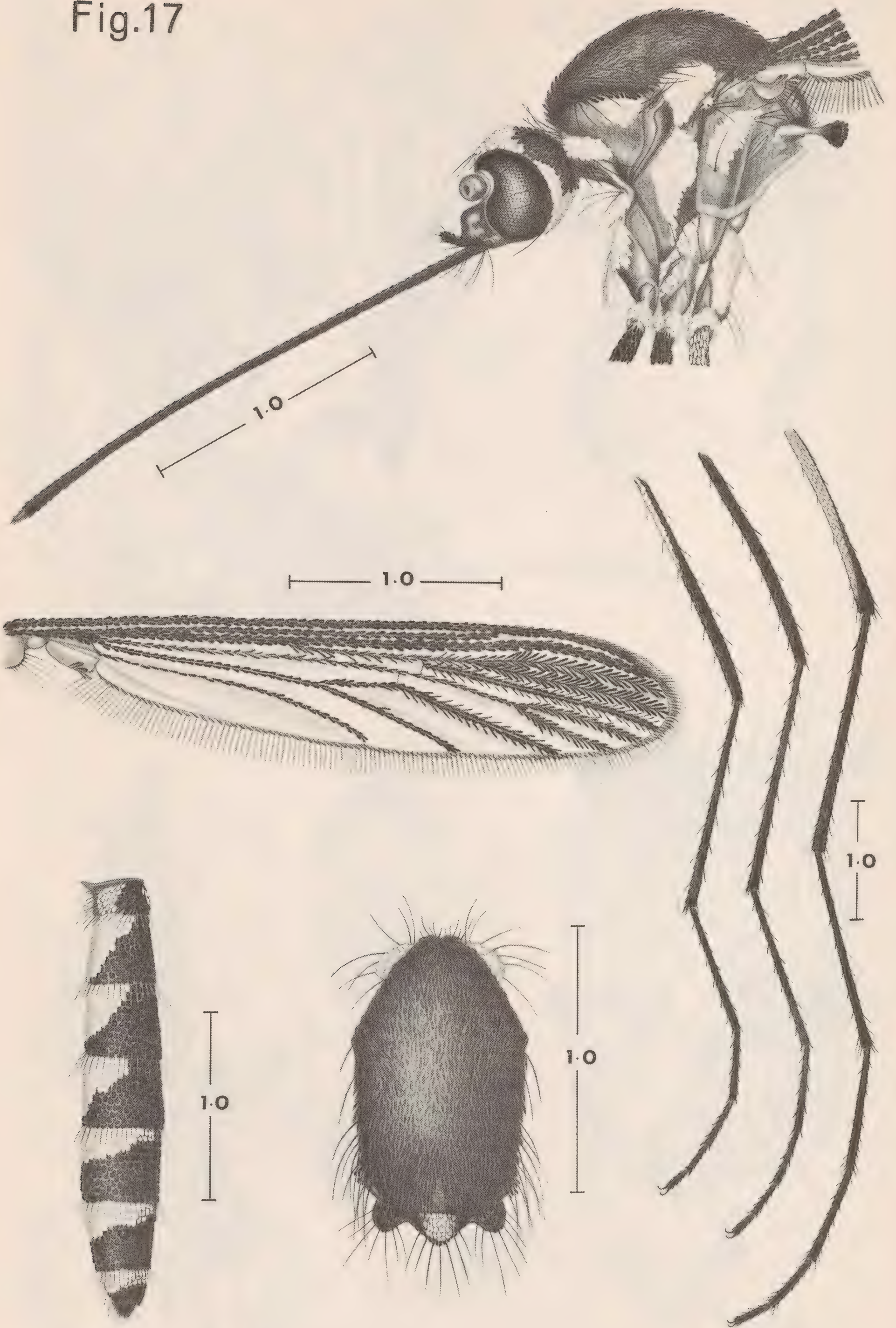


H. (Heizmannia) covelli



H. (Heizmannia) funerea

Fig.17



Kei Daishoji

H. (Heizmannia) demeilloni

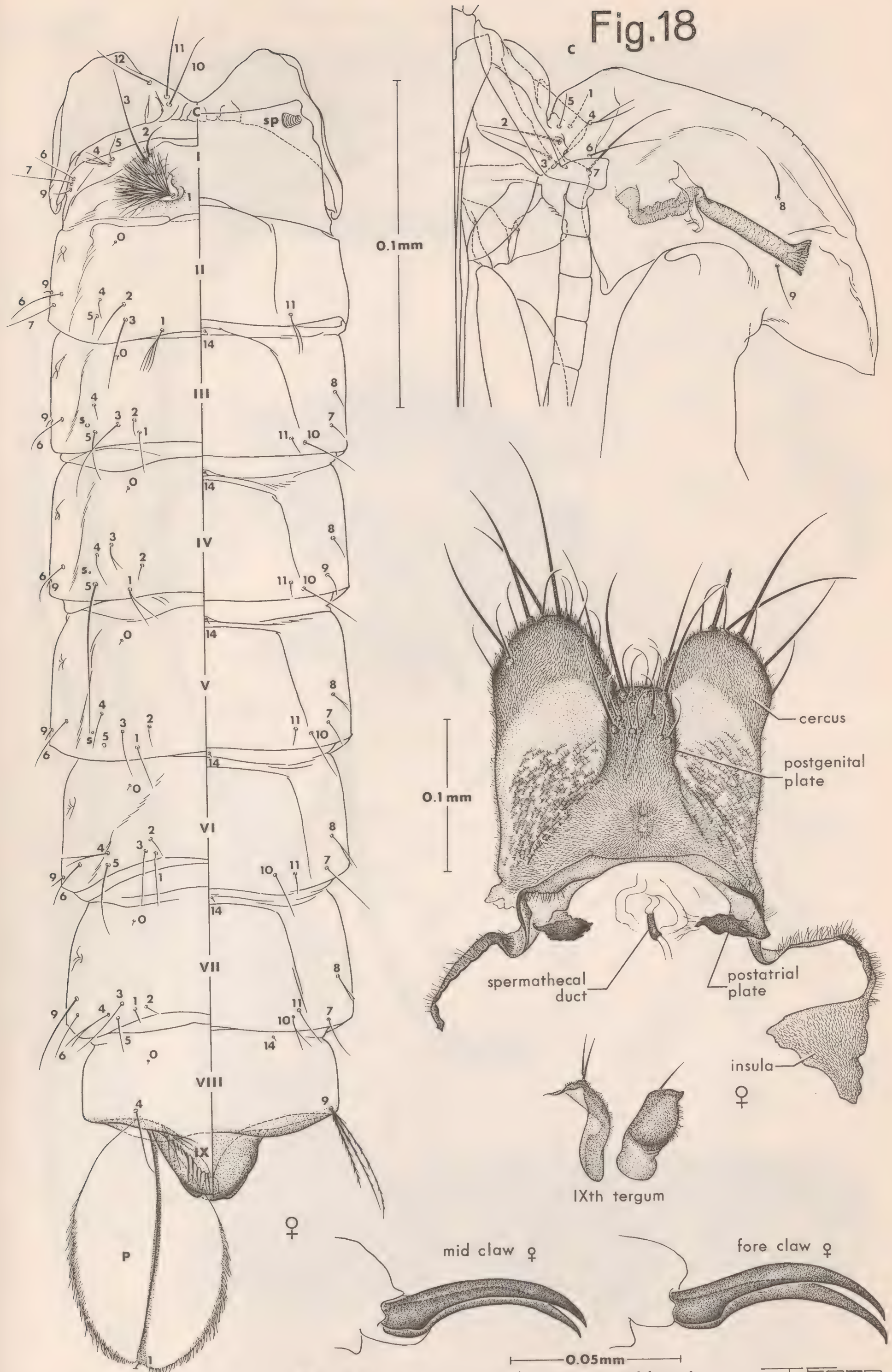


Fig.19



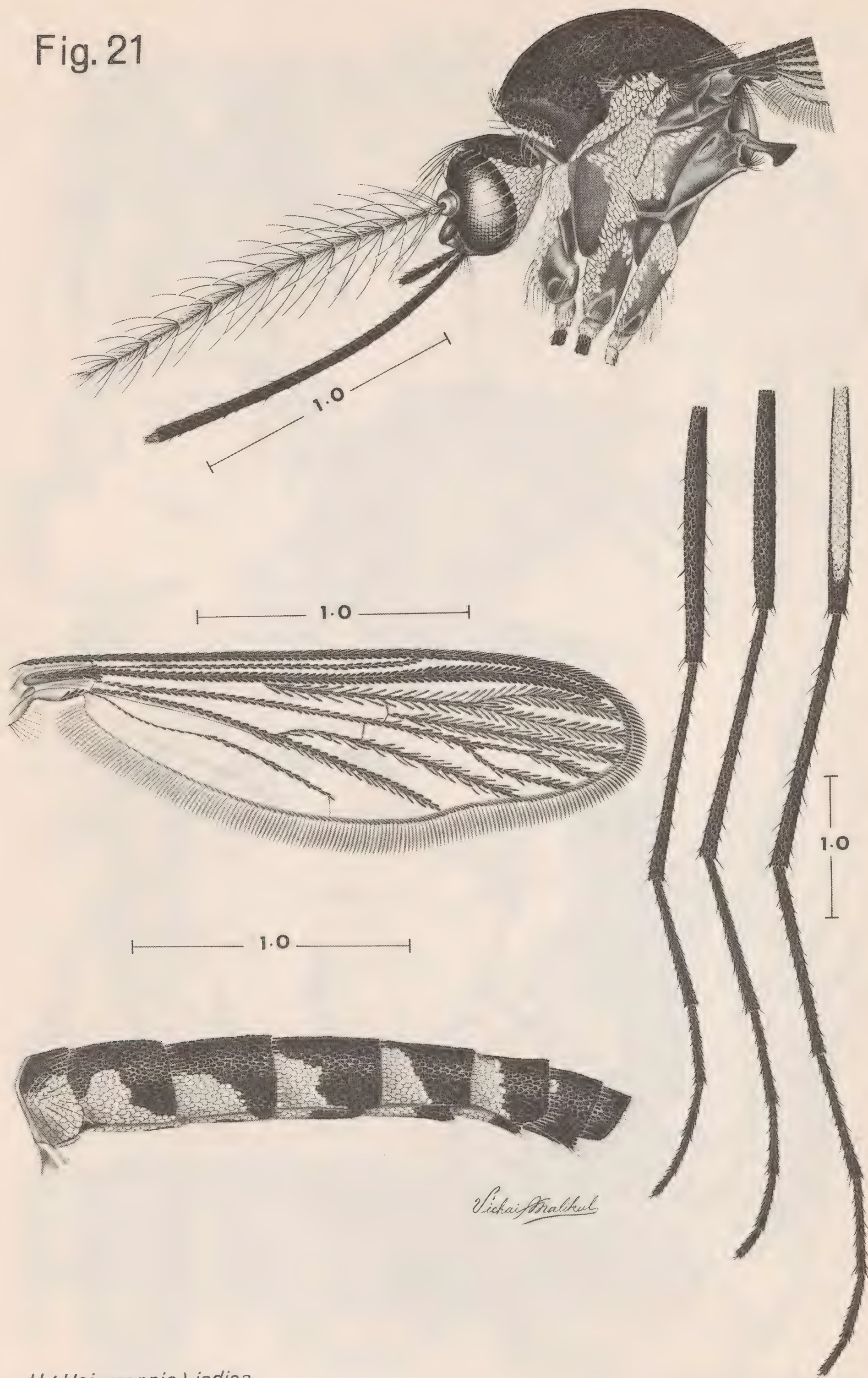
H. (Heizmannia) funerea

Fig. 20



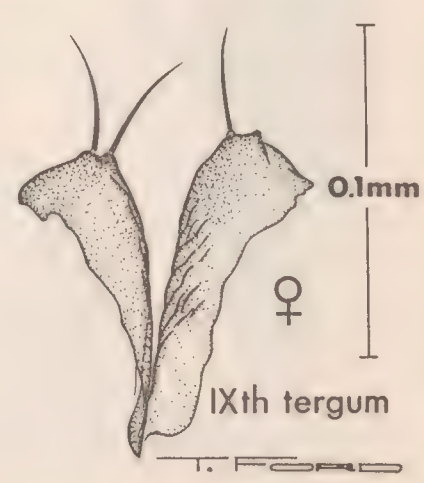
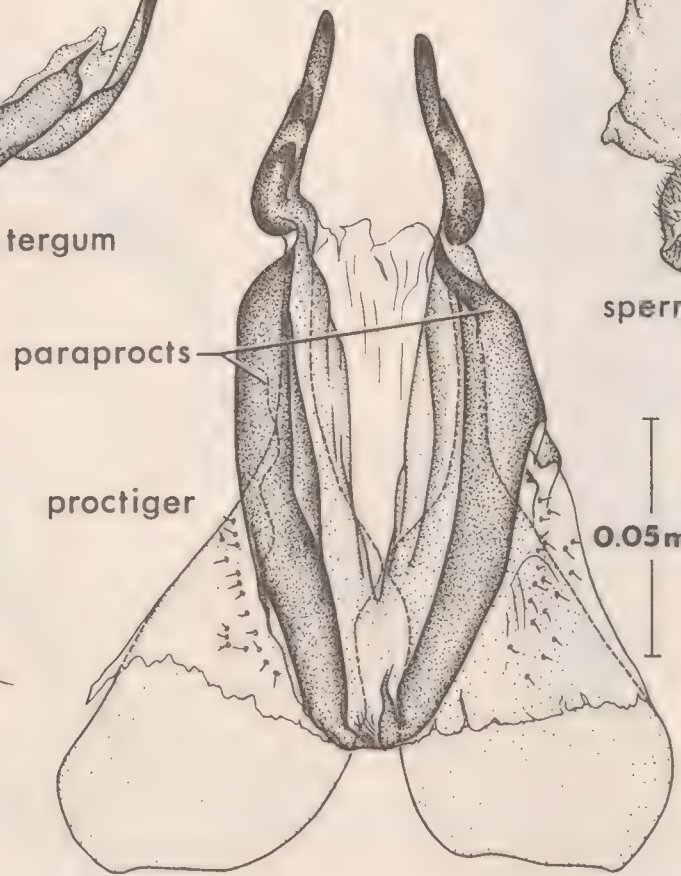
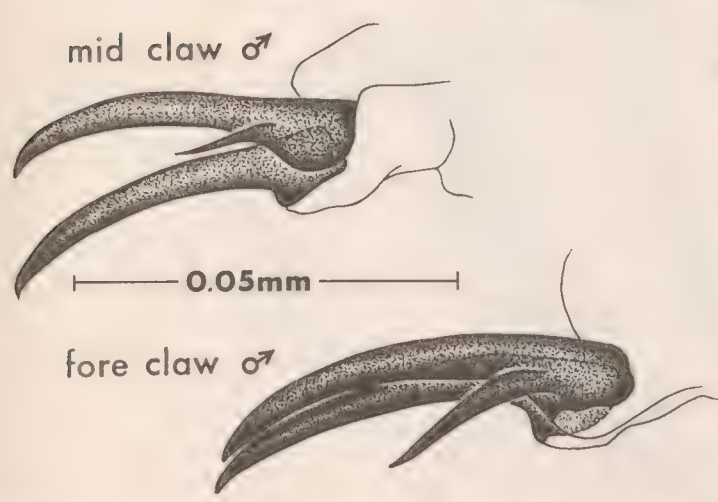
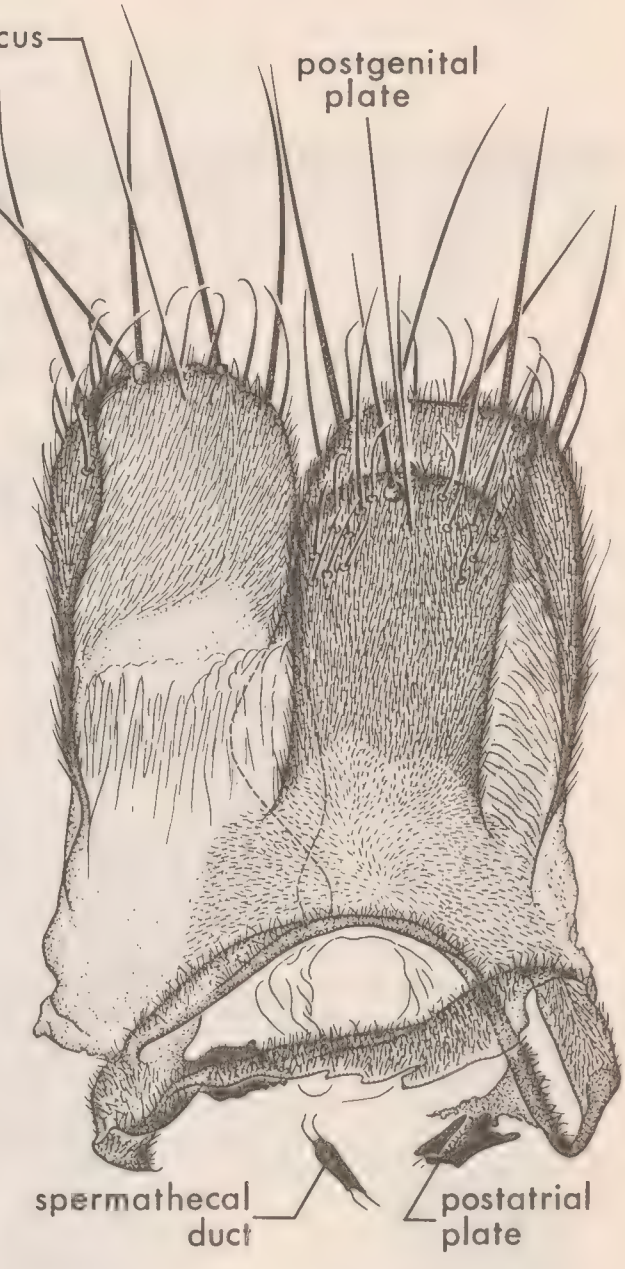
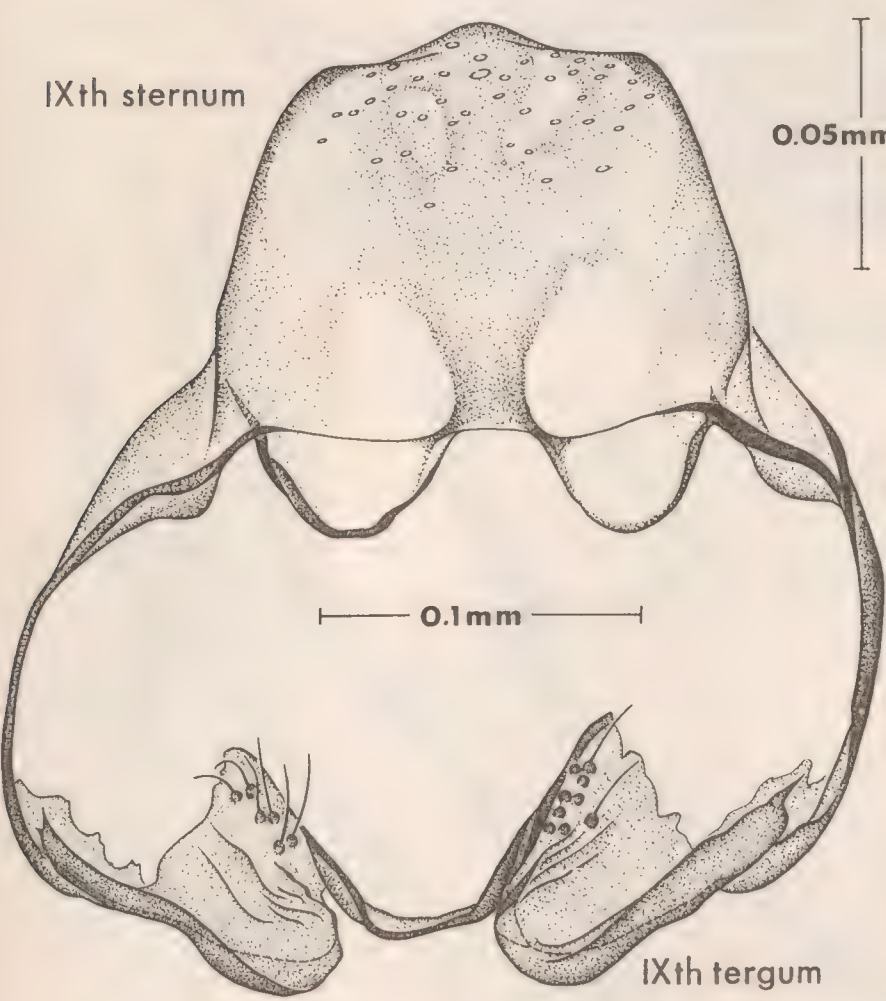
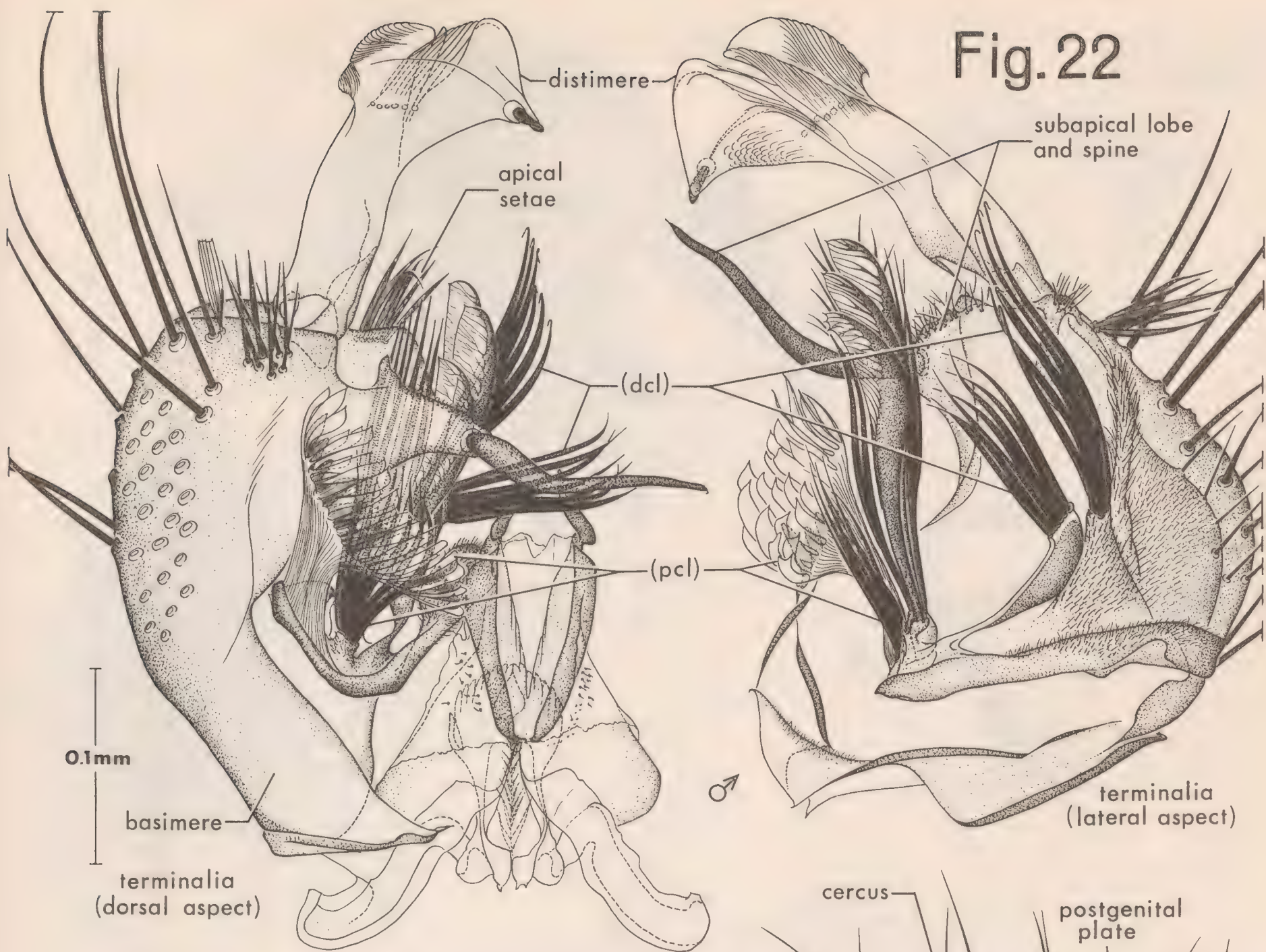
H. (Heizmannia) funerea

Fig. 21



H. (Heizmannia) indica

Fig. 22



H. (Heizmannia) indica

T. Ford

Fig. 23

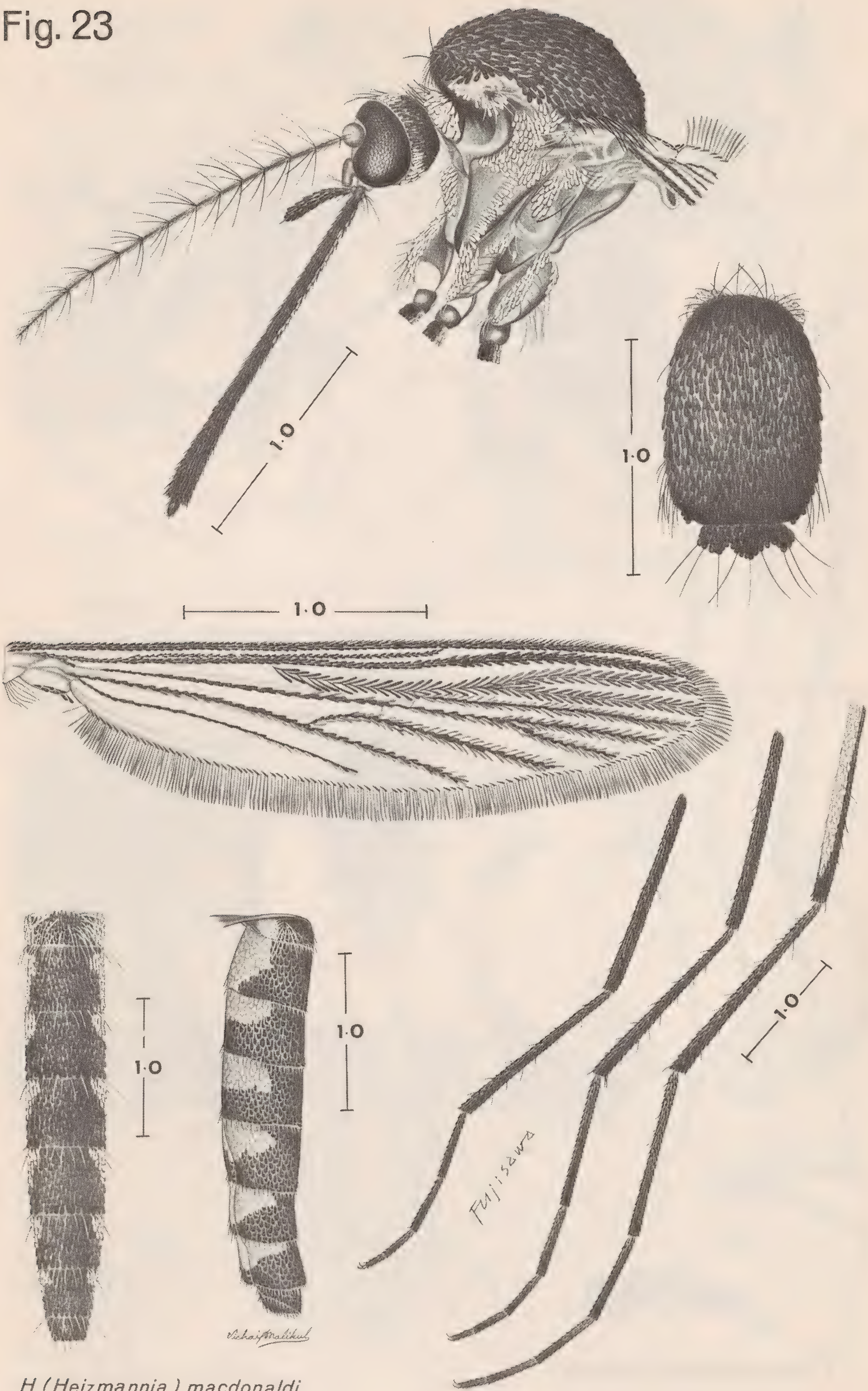
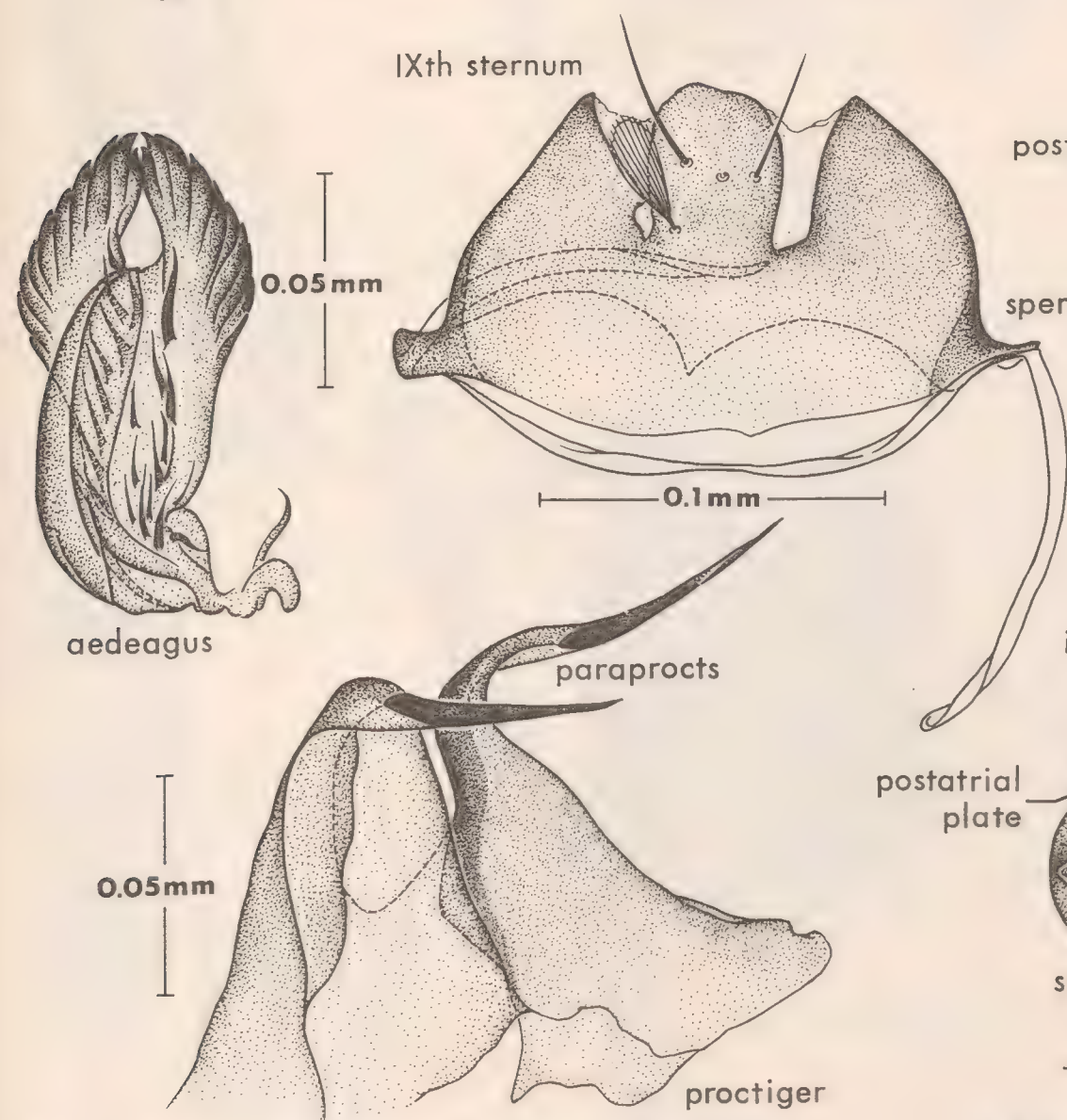
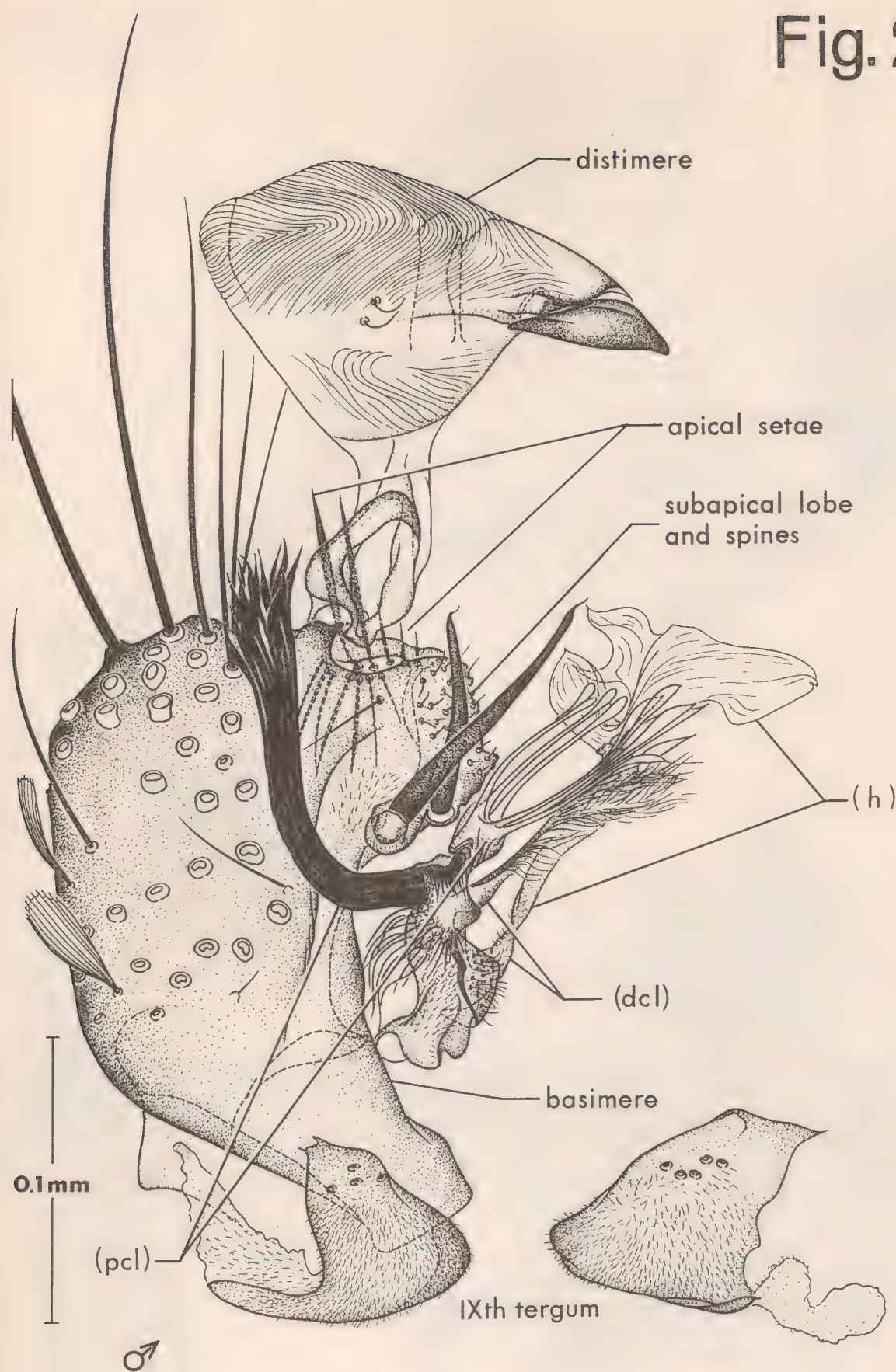
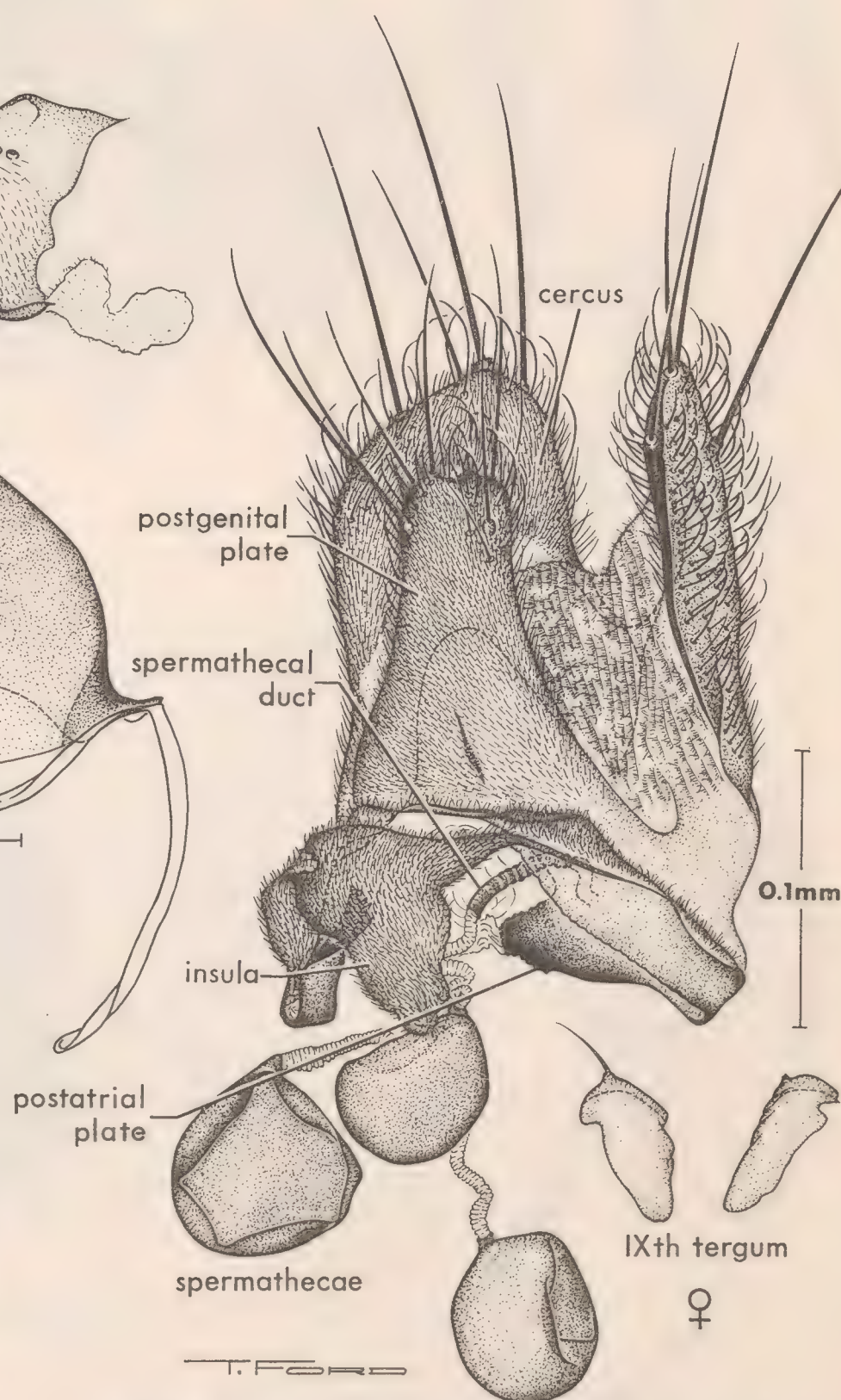
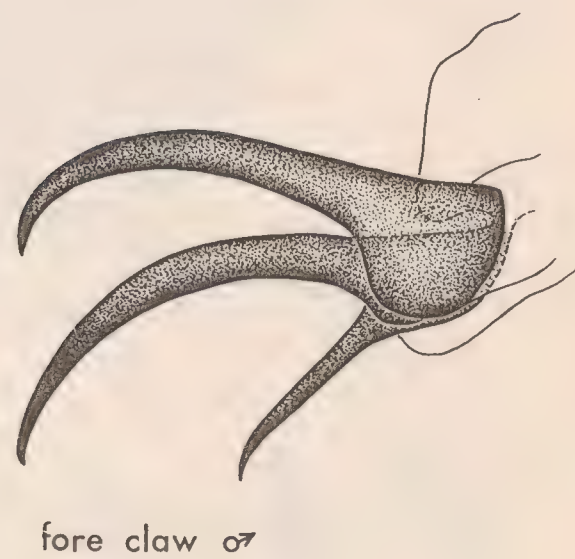
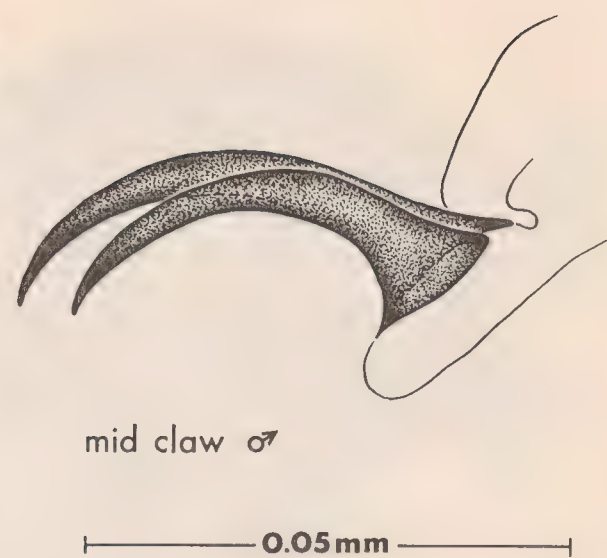


Fig. 24



H. (Heizmannia) macdonaldi



H. (Heizmannia) mattinglyi

Fig. 25



H. (Heizmannia) macdonaldi

Fig. 26

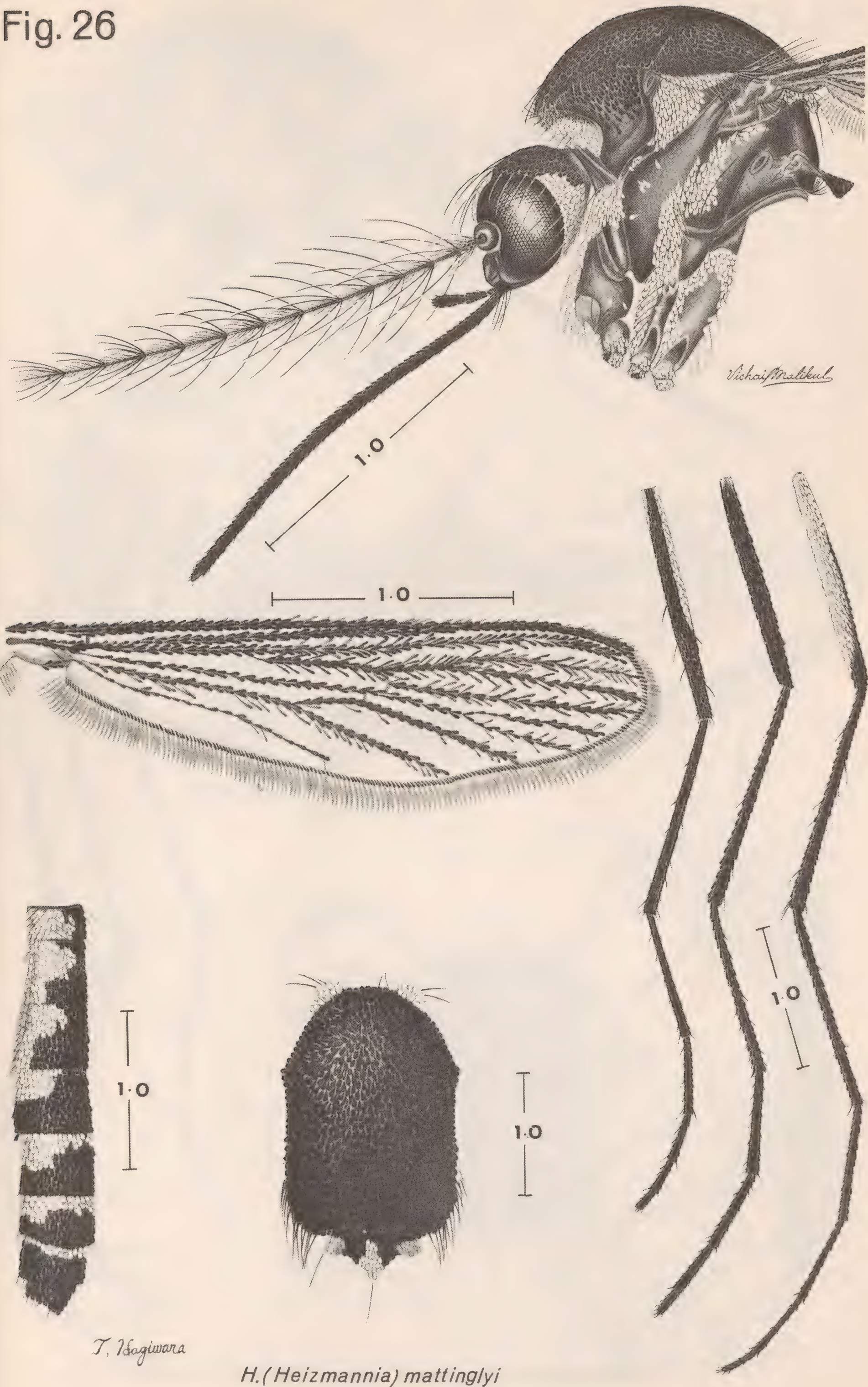
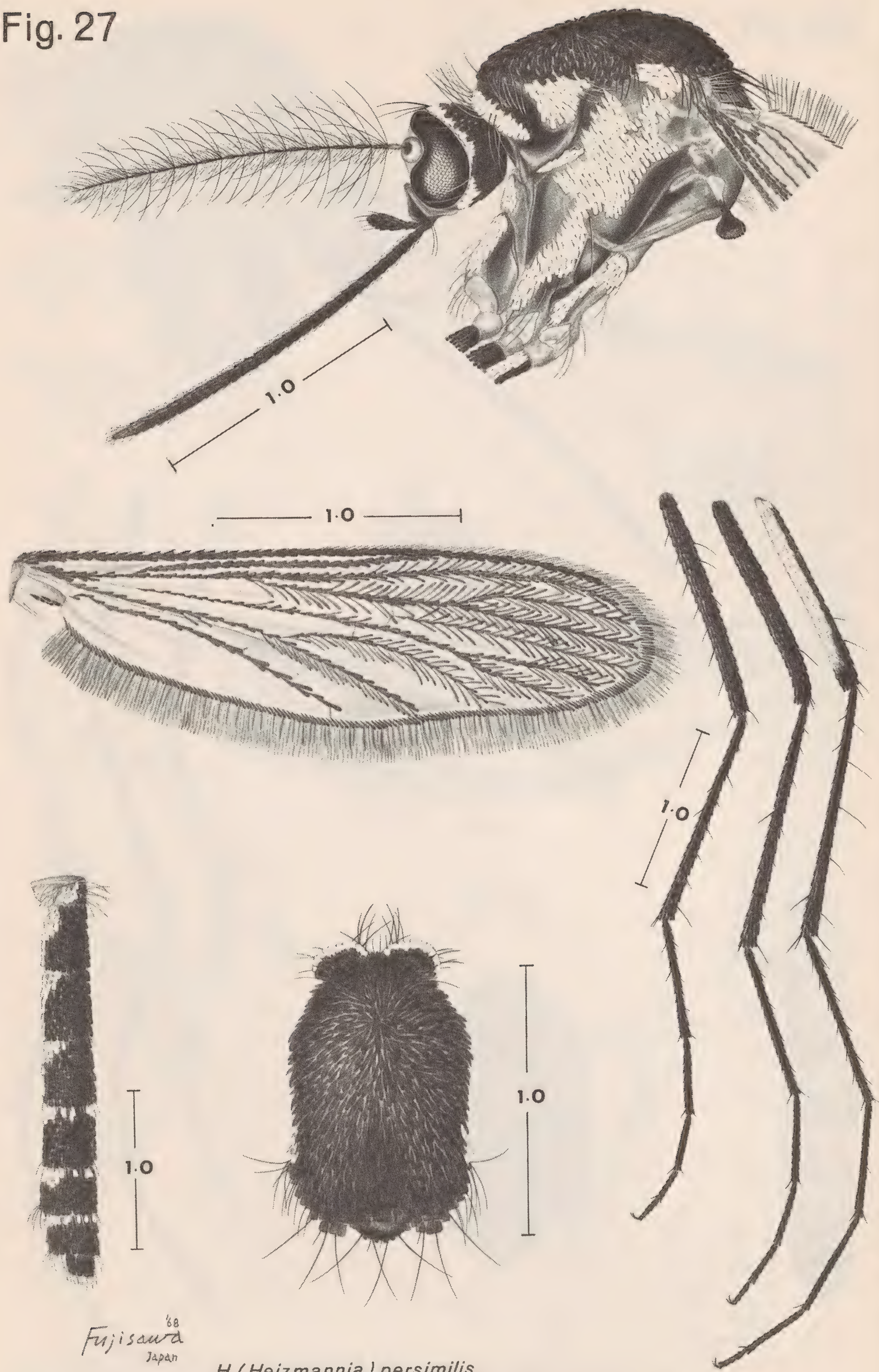


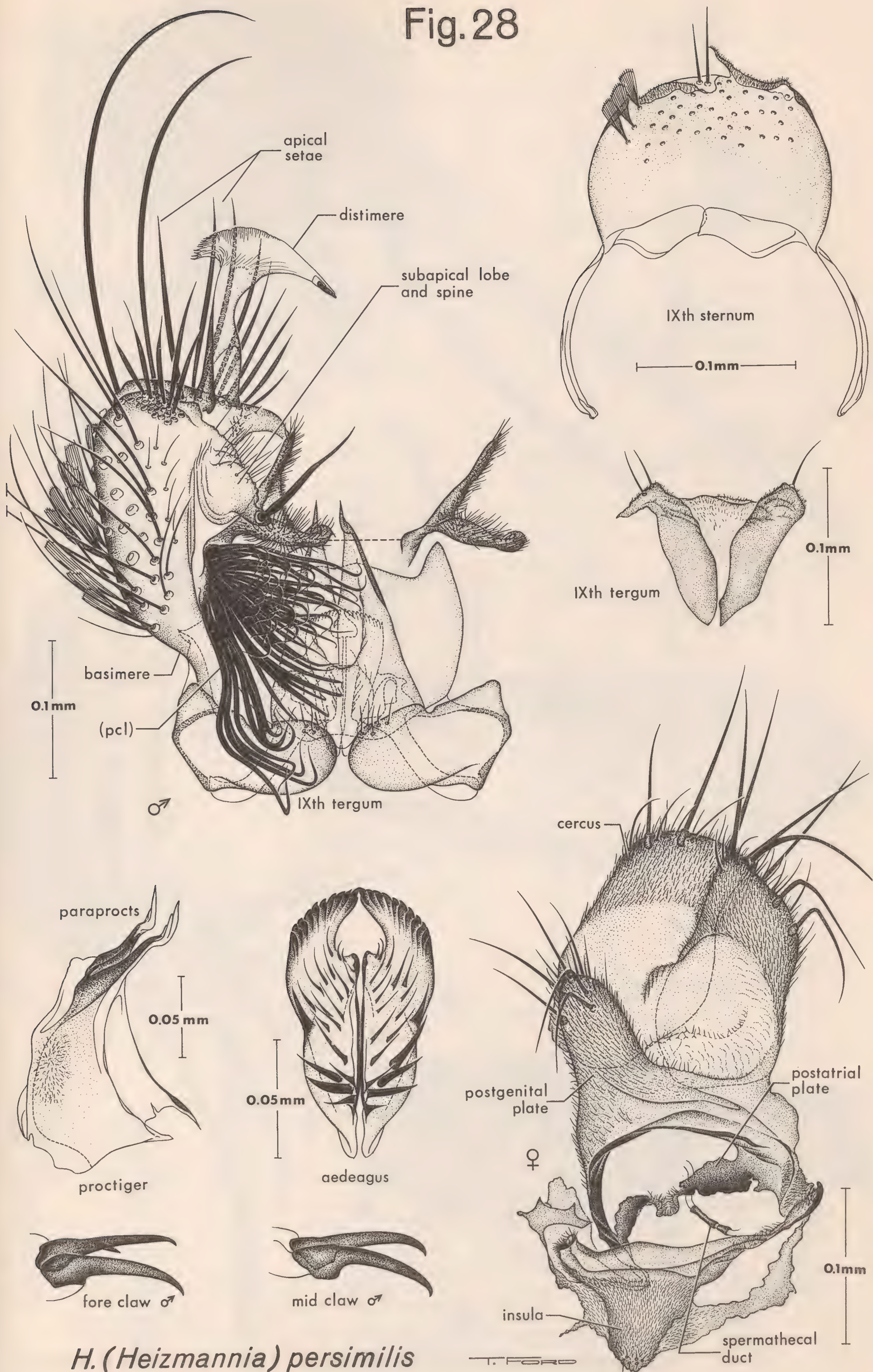
Fig. 27



Fujisawa^{'88}
Japan

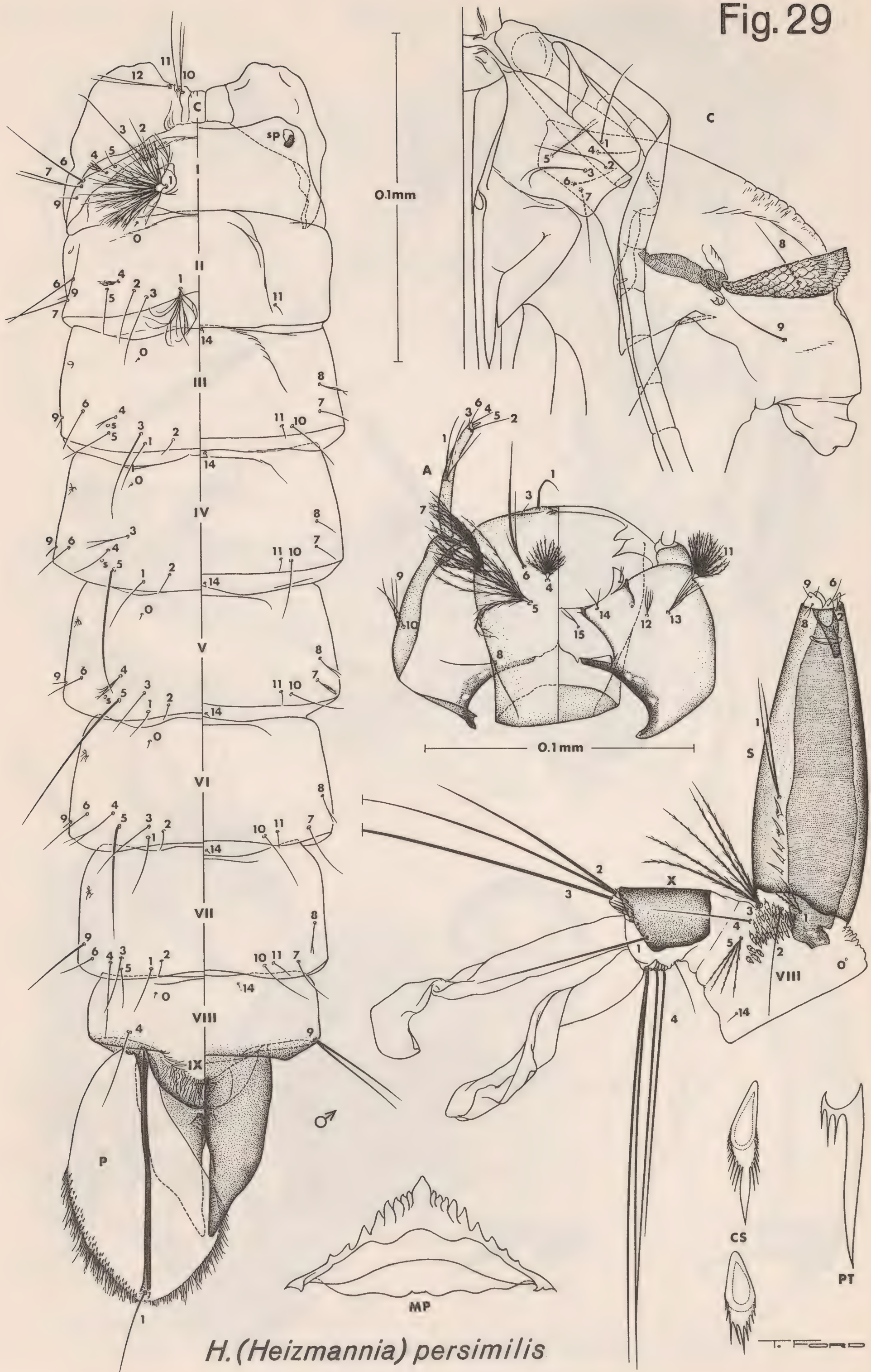
H. (Heizmannia) persimilis

Fig. 28



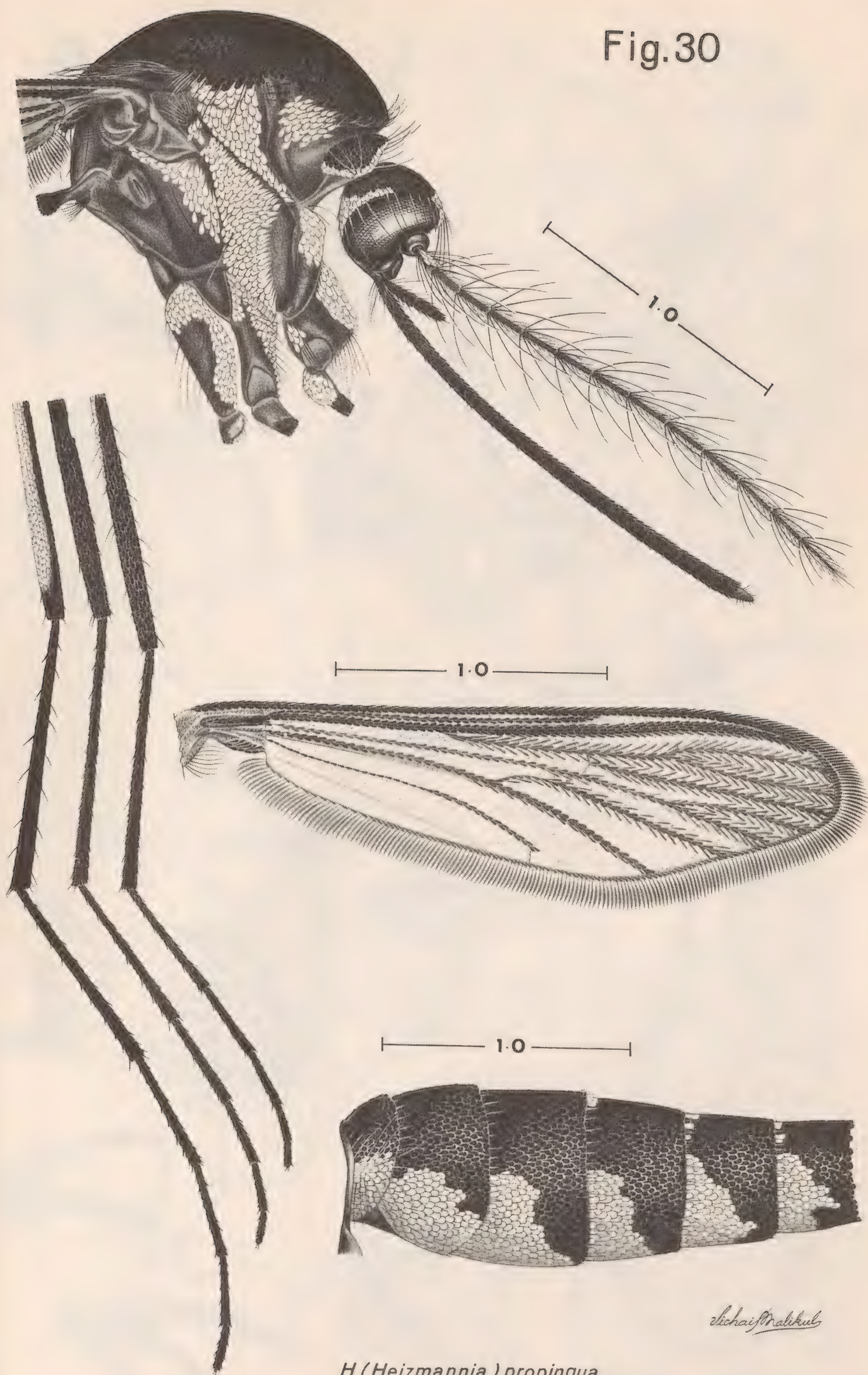
H. (Heizmannia) persimilis

Fig. 29



H. (Heizmannia) persimilis

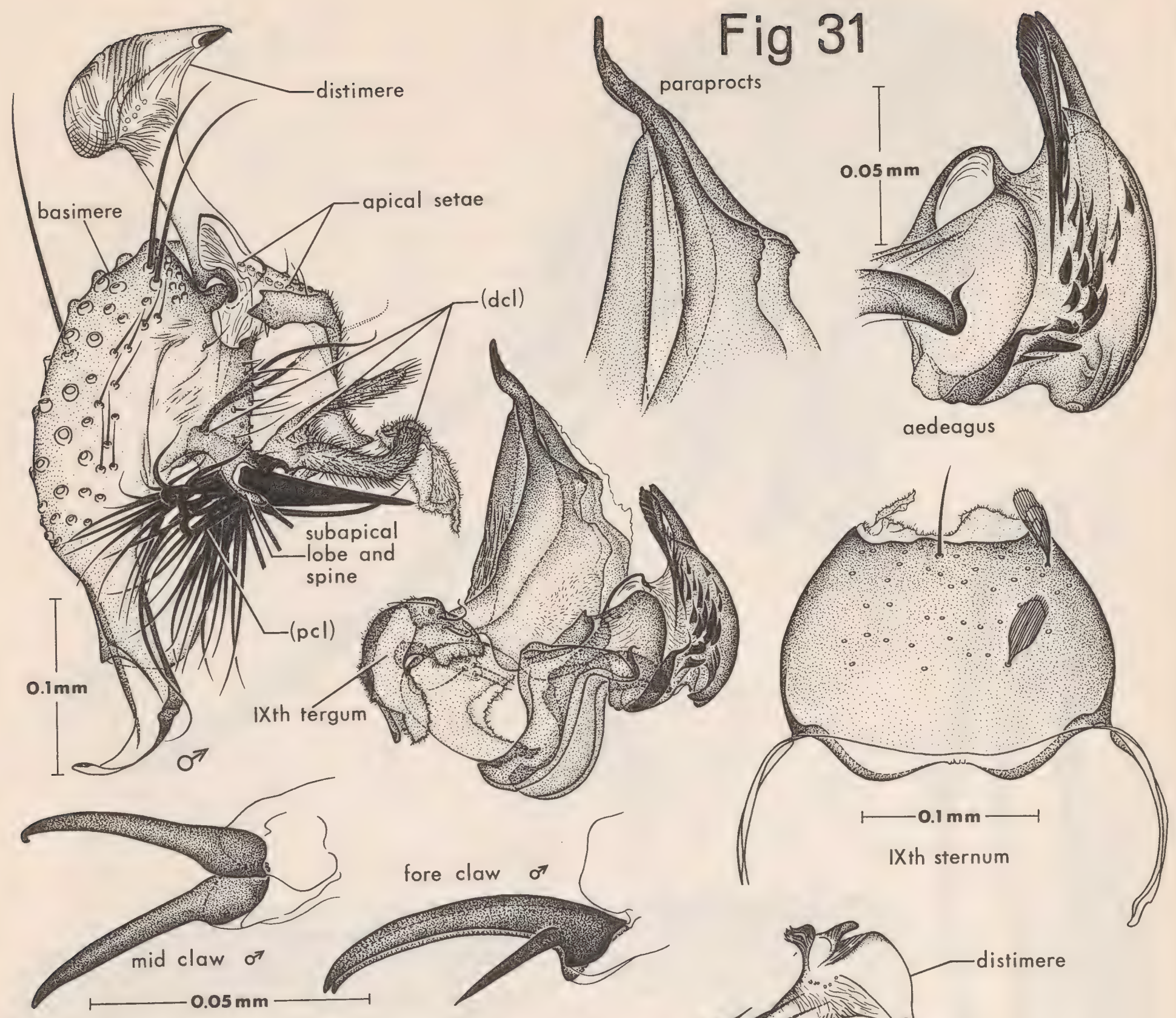
Fig.30



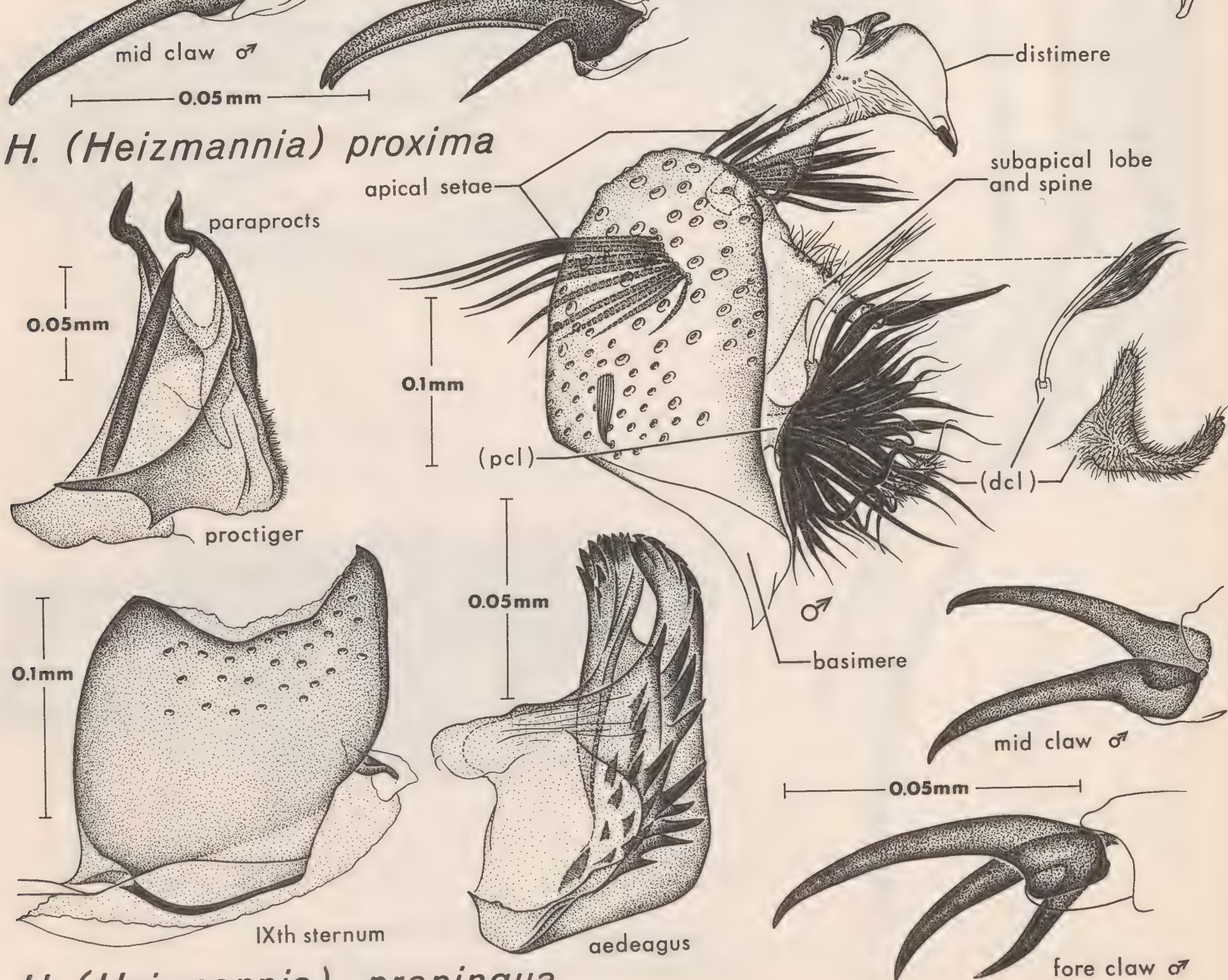
Richard Malikul

H. (Heizmannia) propinqua

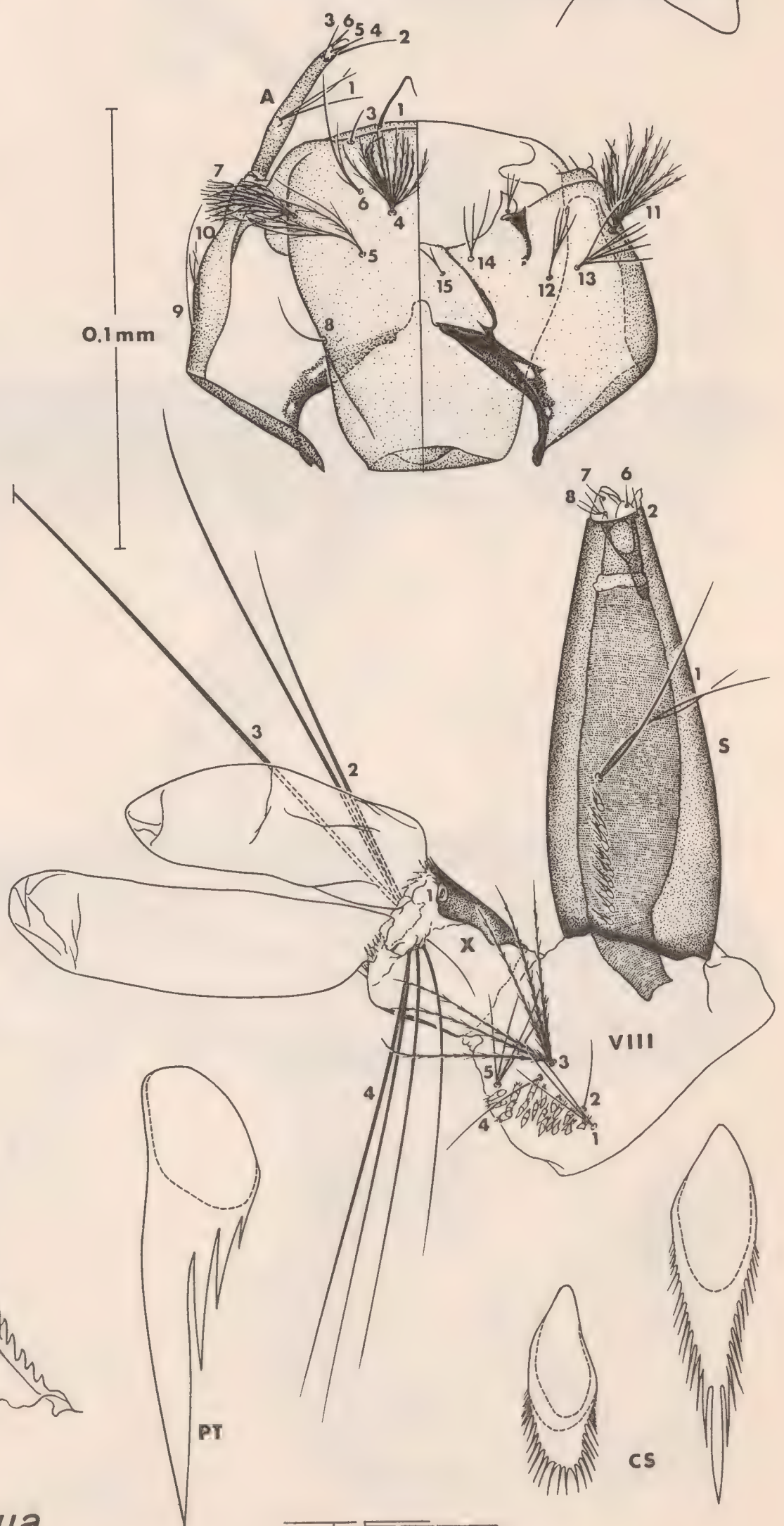
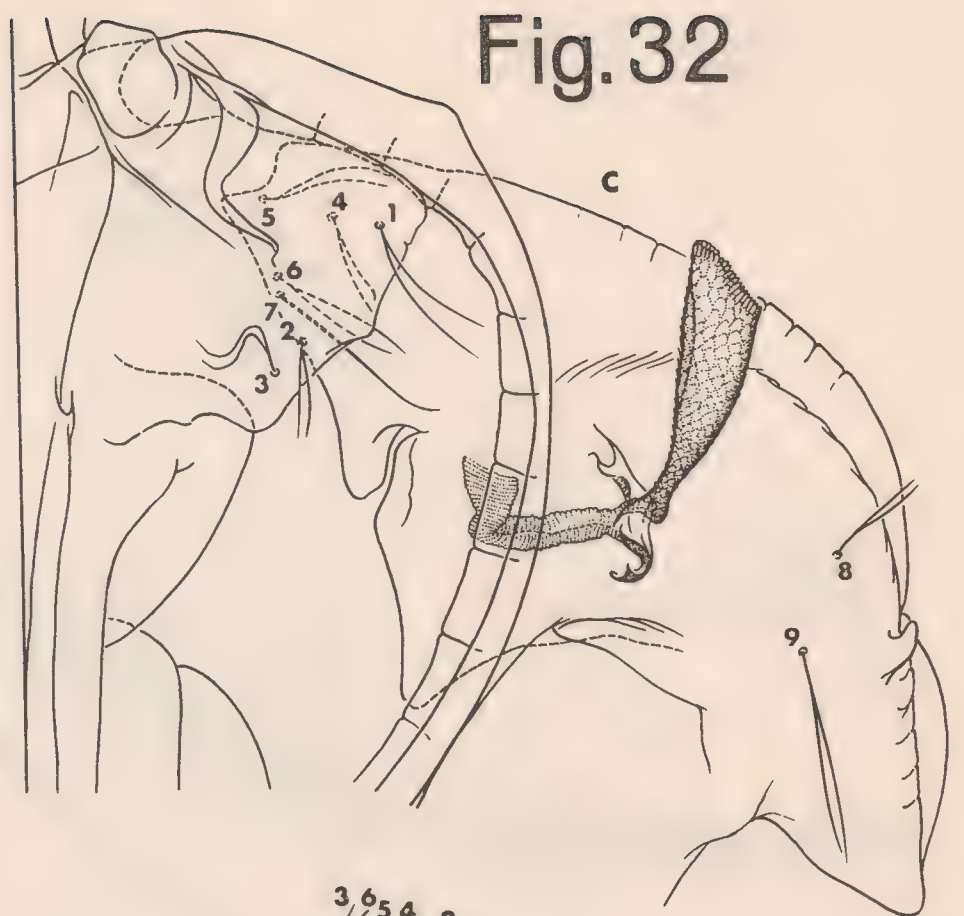
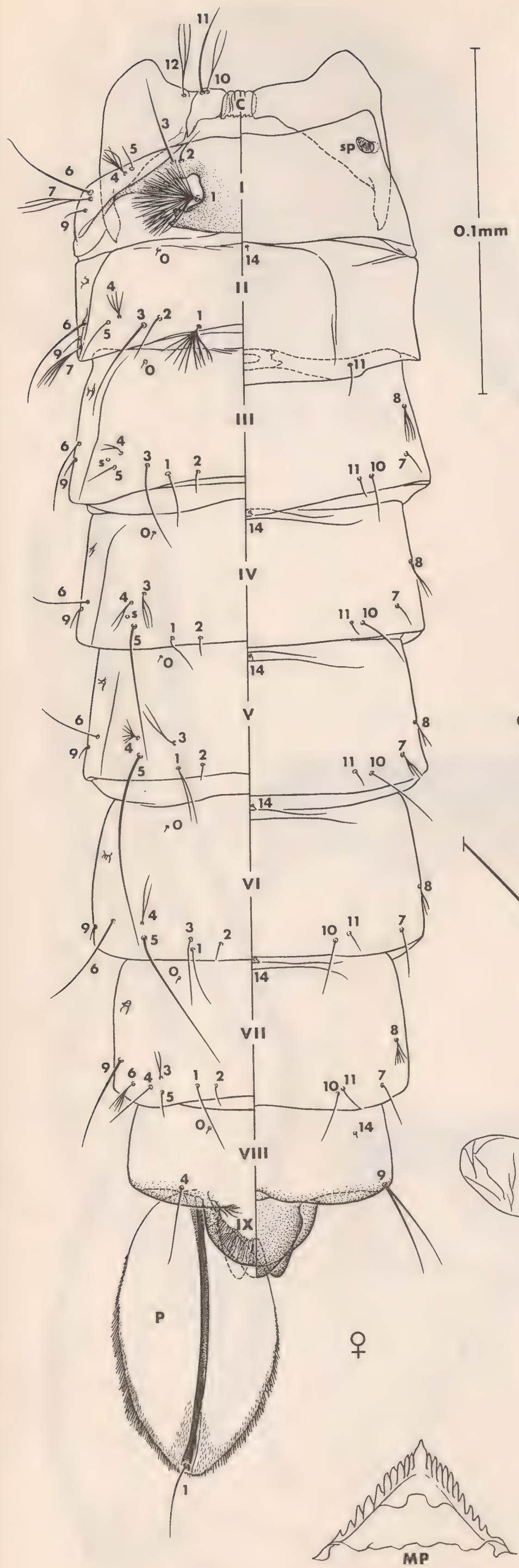
Fig 31



H. (Heizmannia) proxima

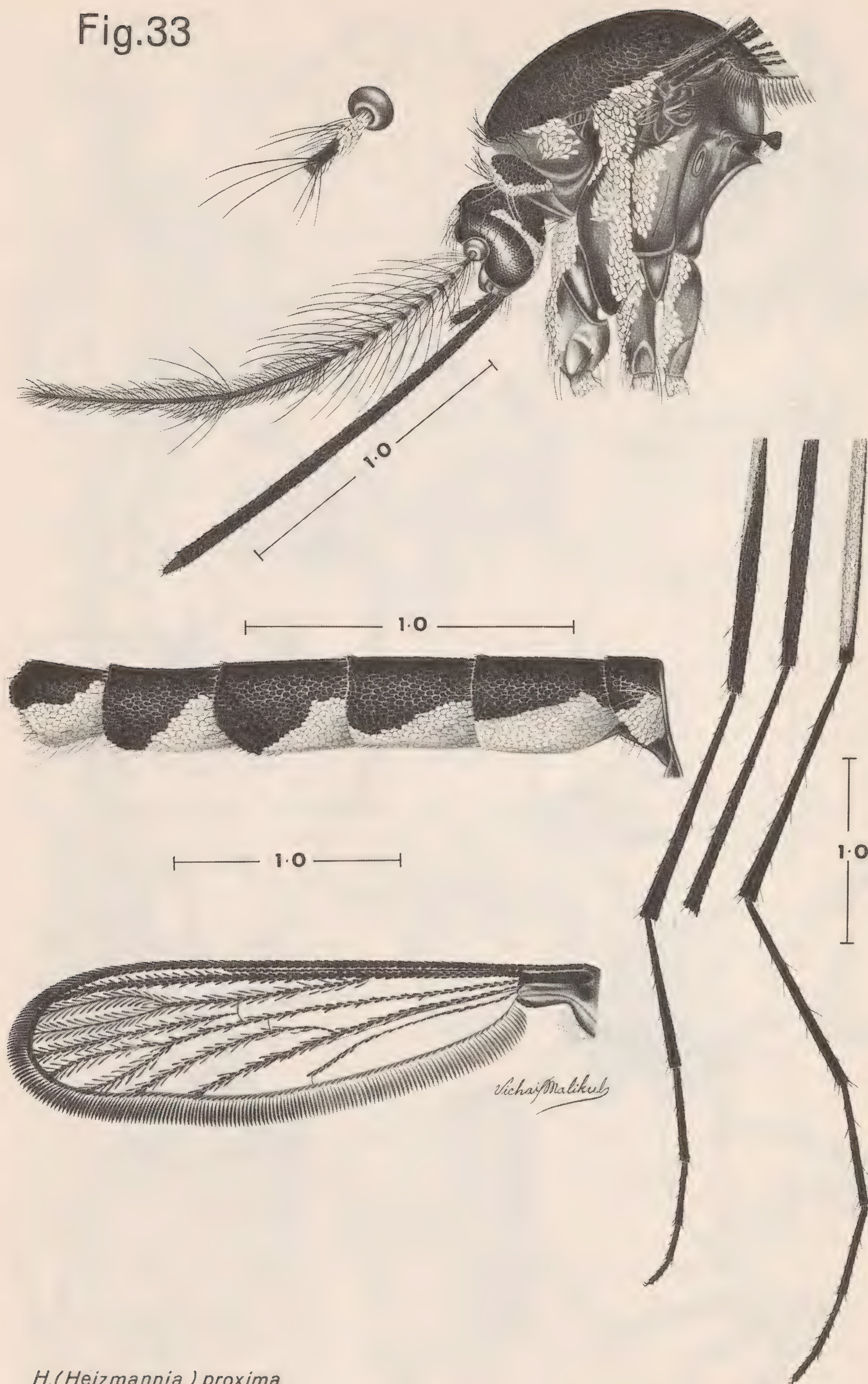


H. (Heizmannia) propinqua



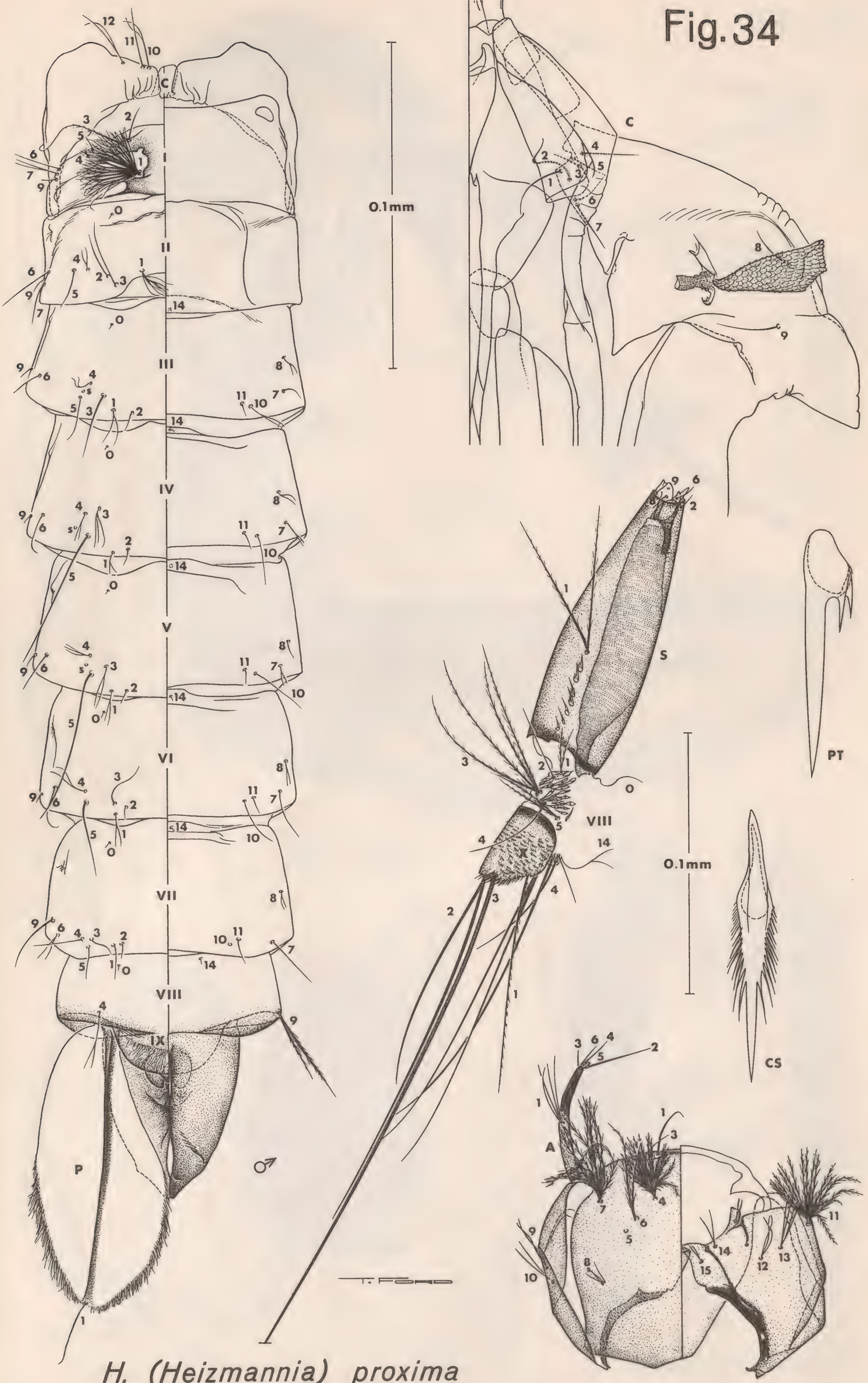
H. (Heizmannia) propinqua

Fig.33



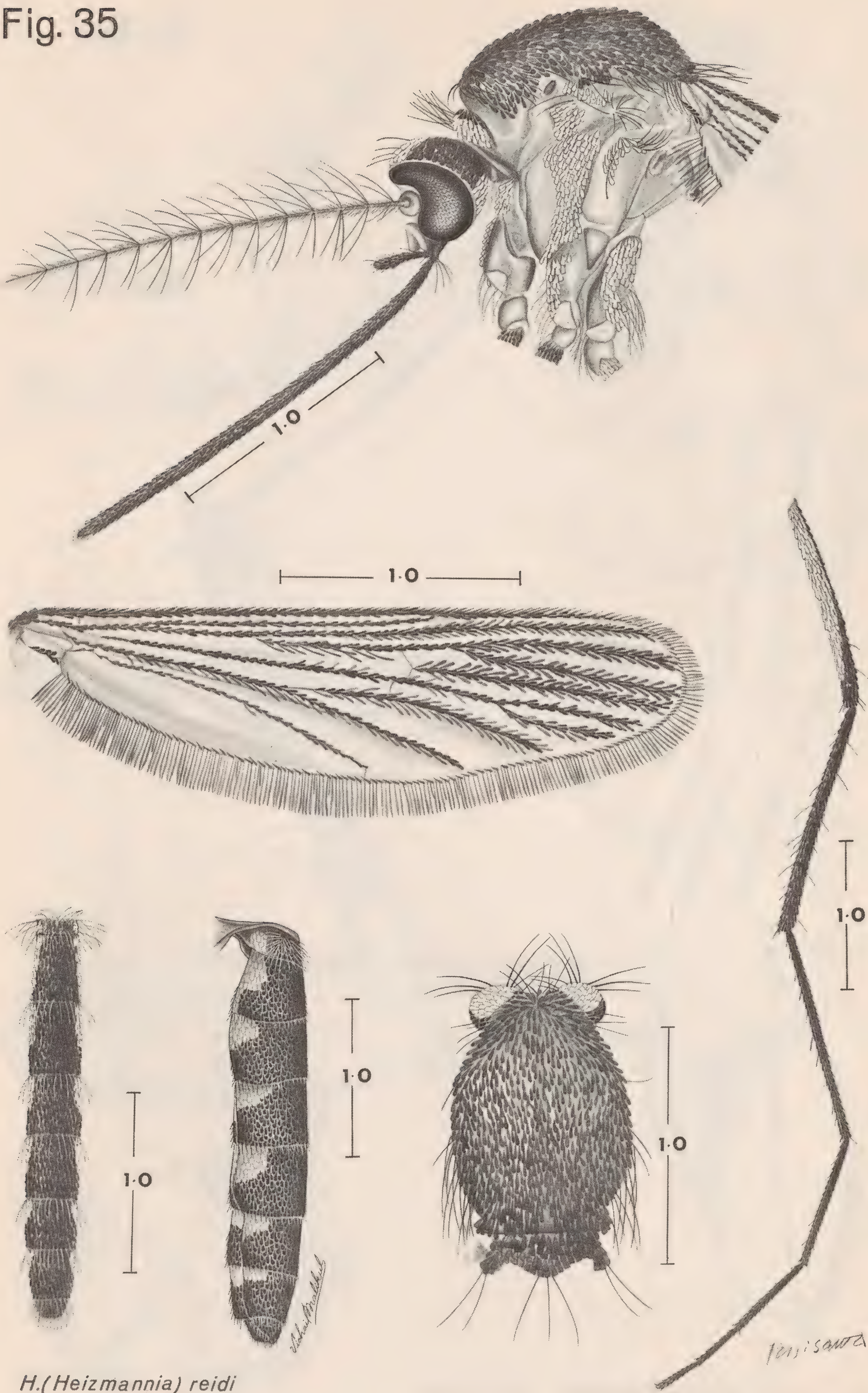
H. (Heizmannia) proxima

Fig. 34



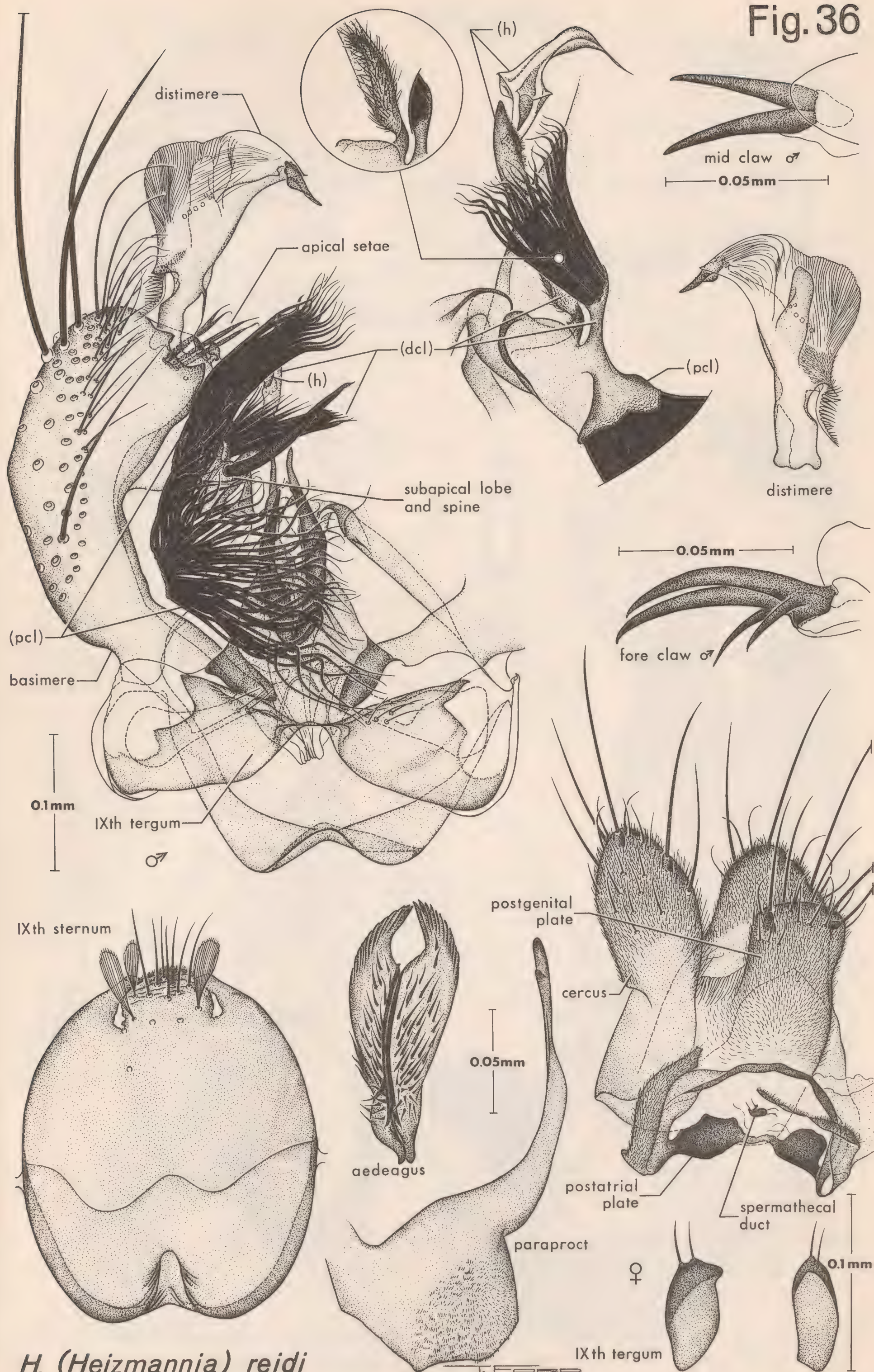
H. (Heizmannia) proxima

Fig. 35



H. (Heizmannia) reidi

Fig. 36



H. (Heizmannia) reidi

Fig. 37

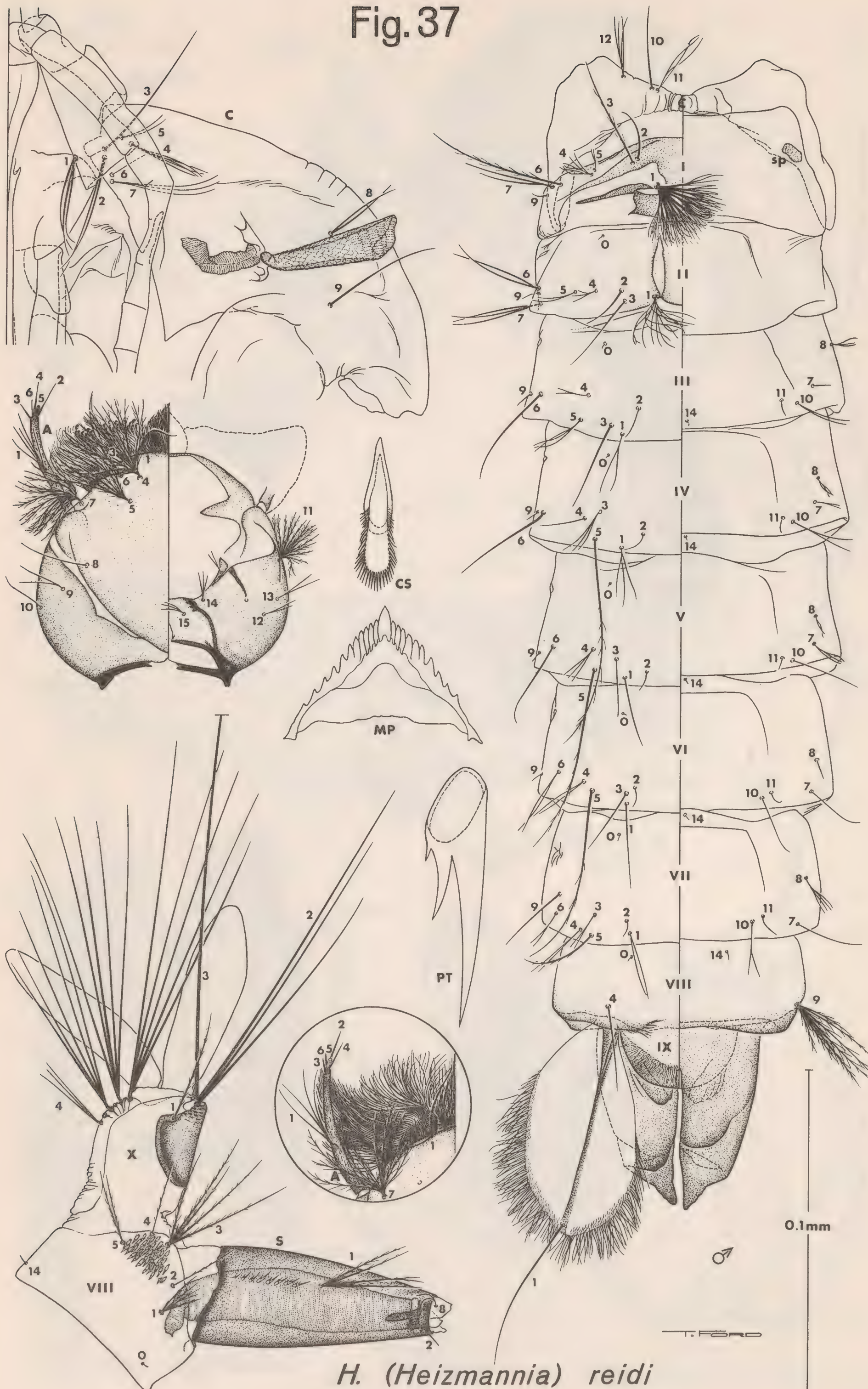
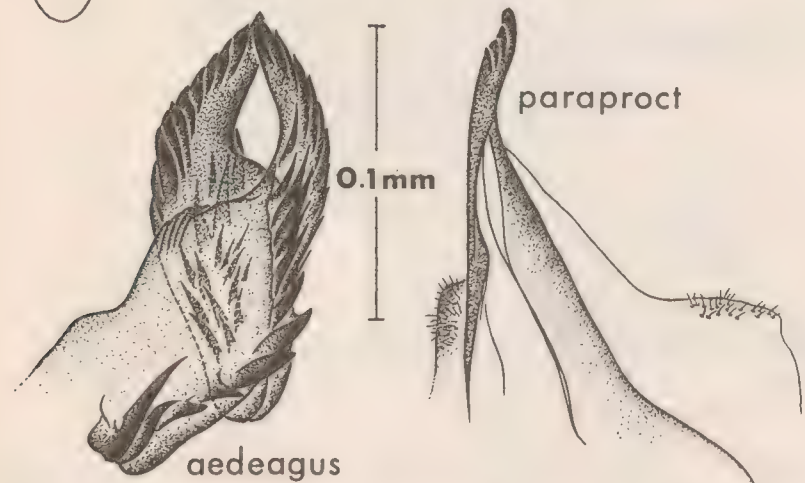
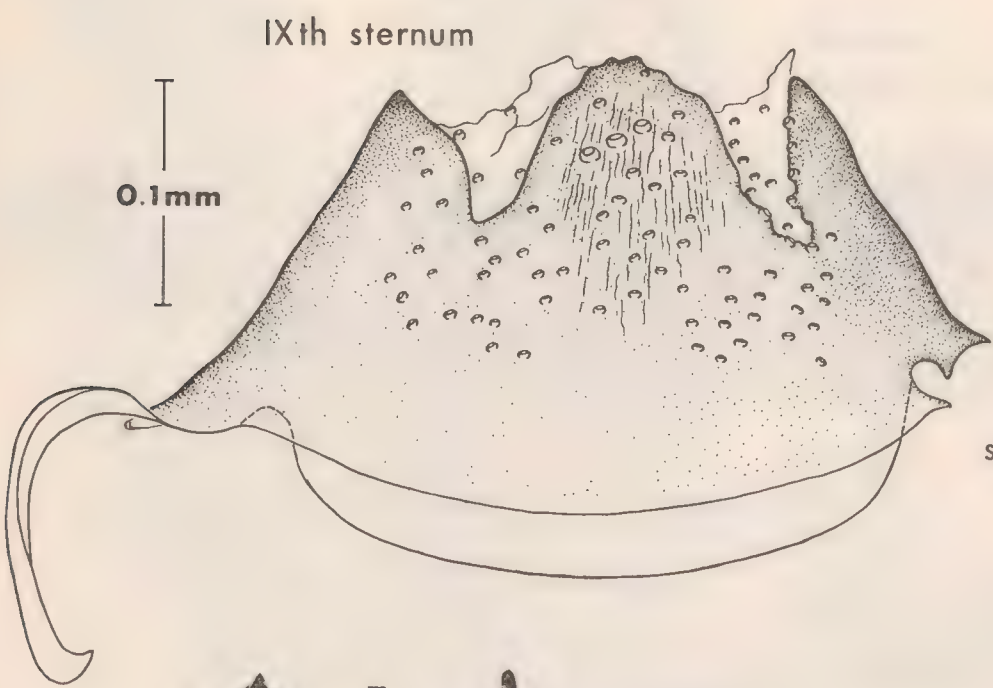
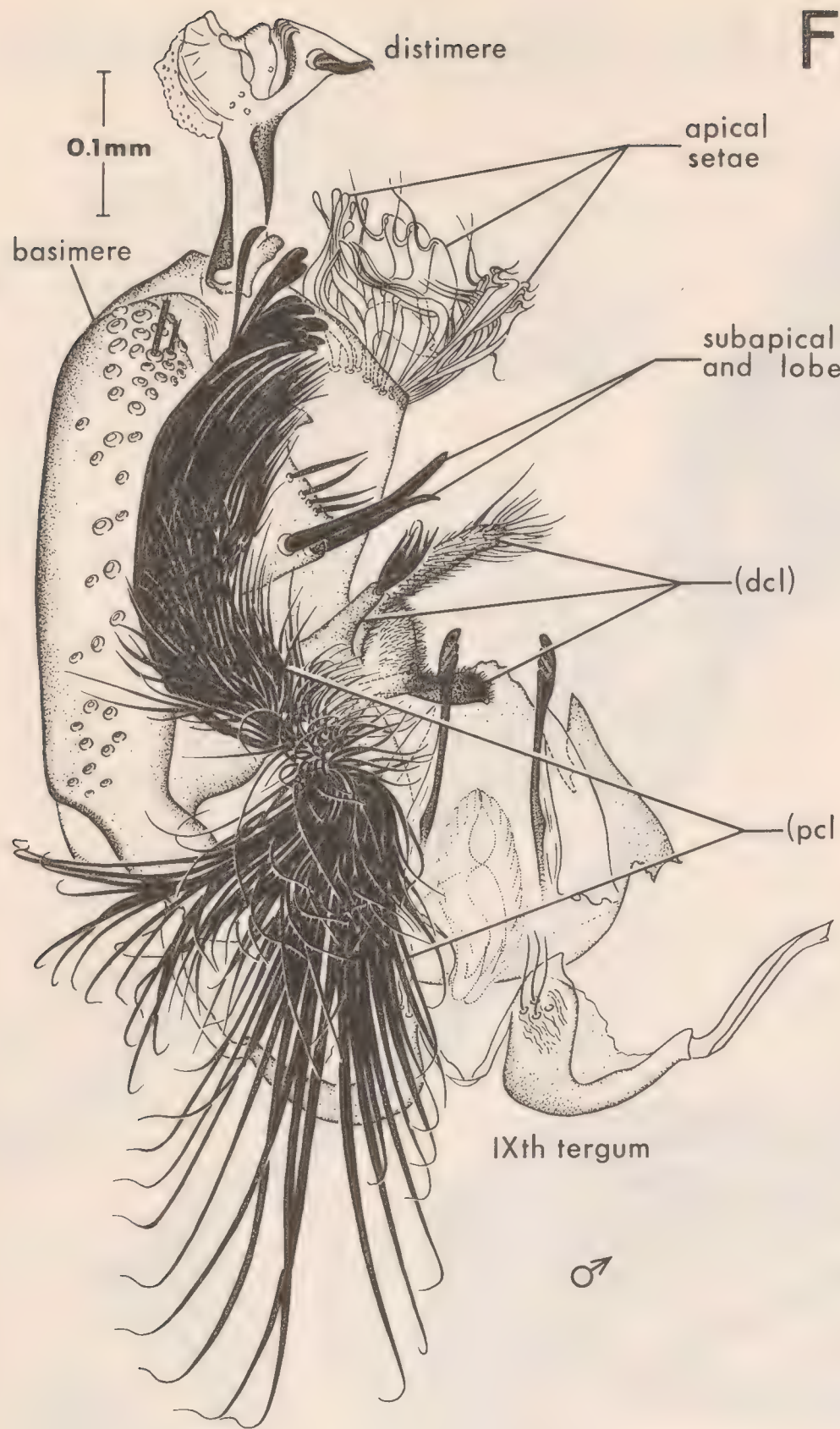
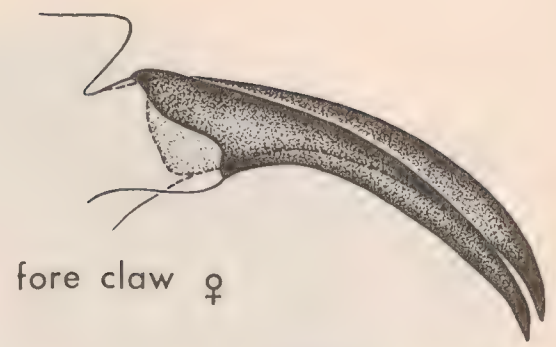


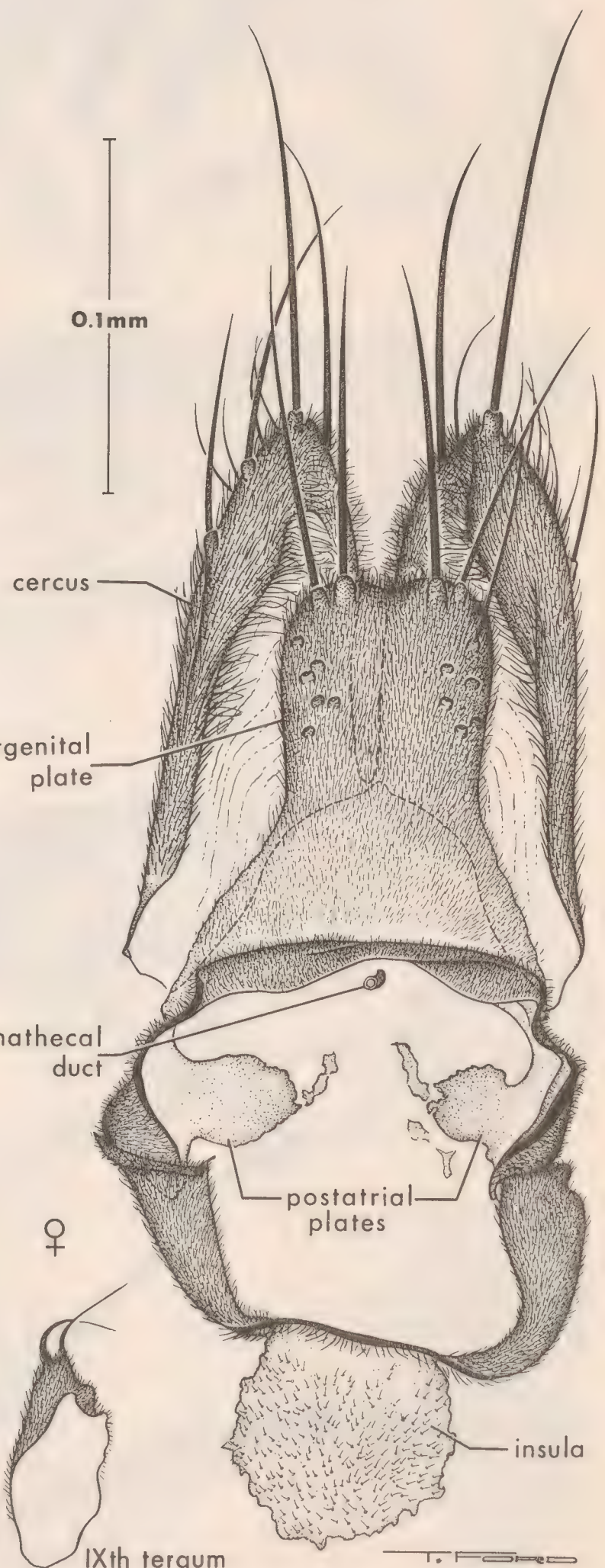
Fig.38



H. (Heizmannia) scanloni

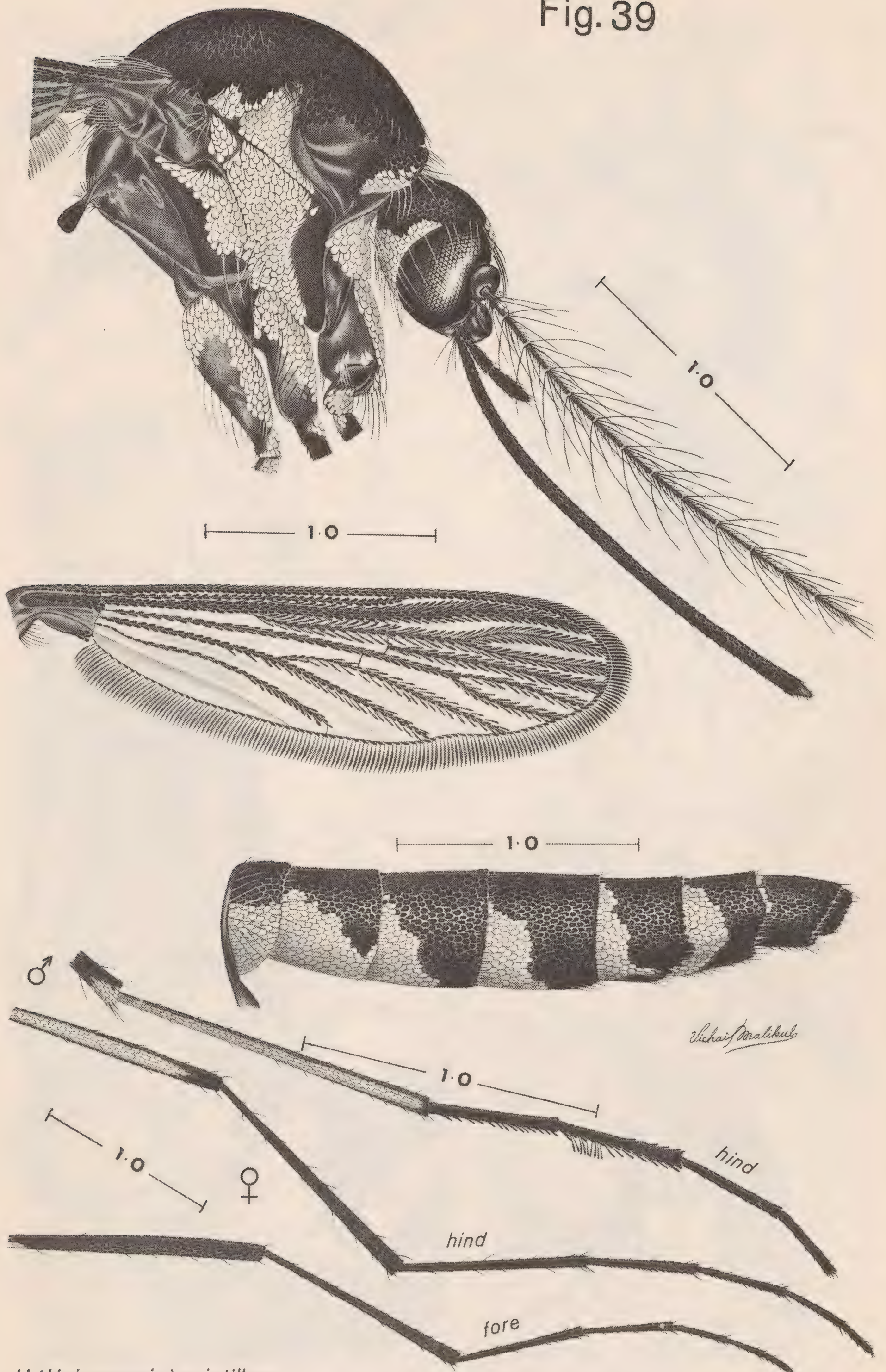


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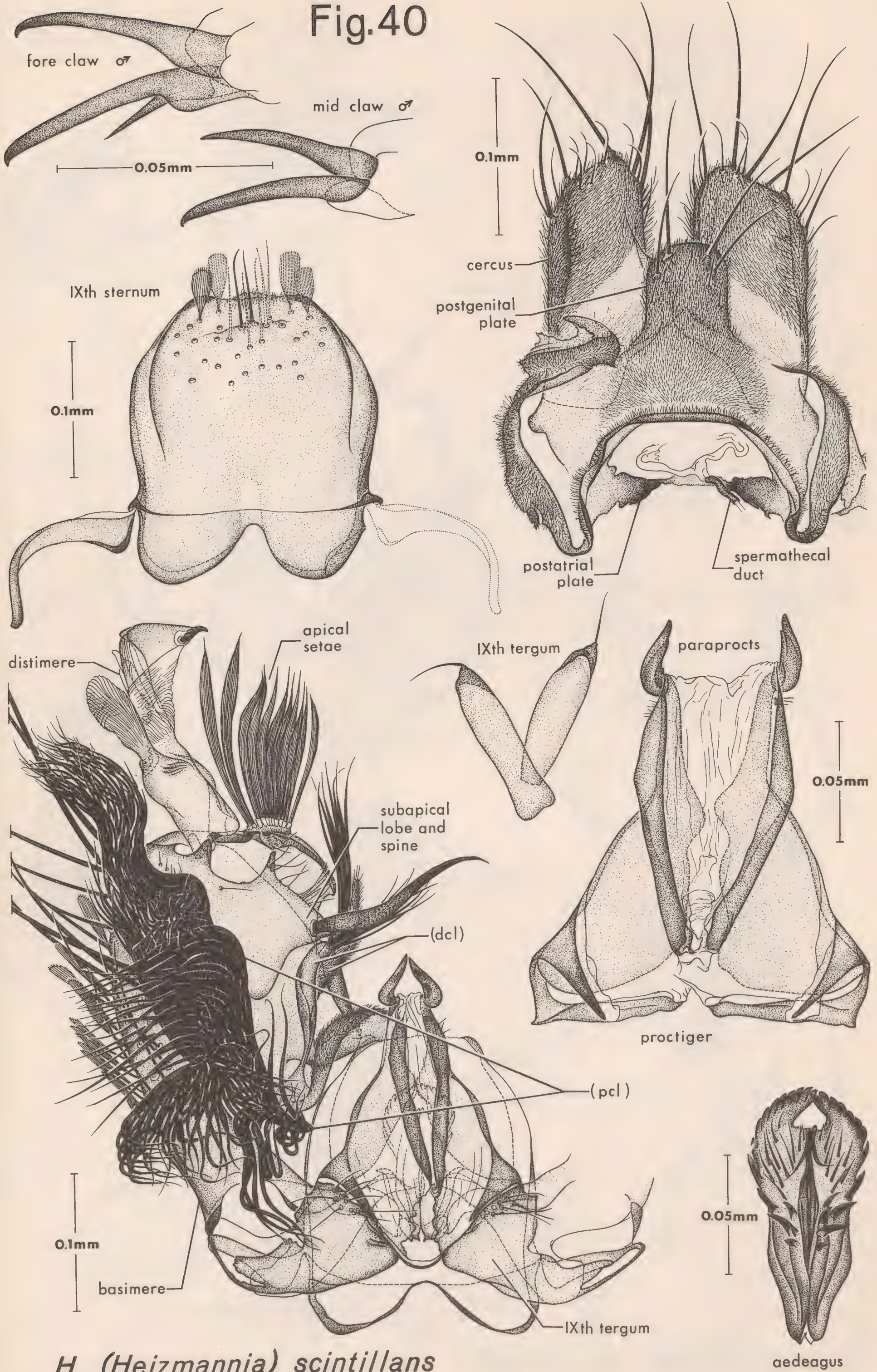
H. (Mattinglyia) thelmae

Fig. 39



H. (Heizmannia) scintillans

Fig.40

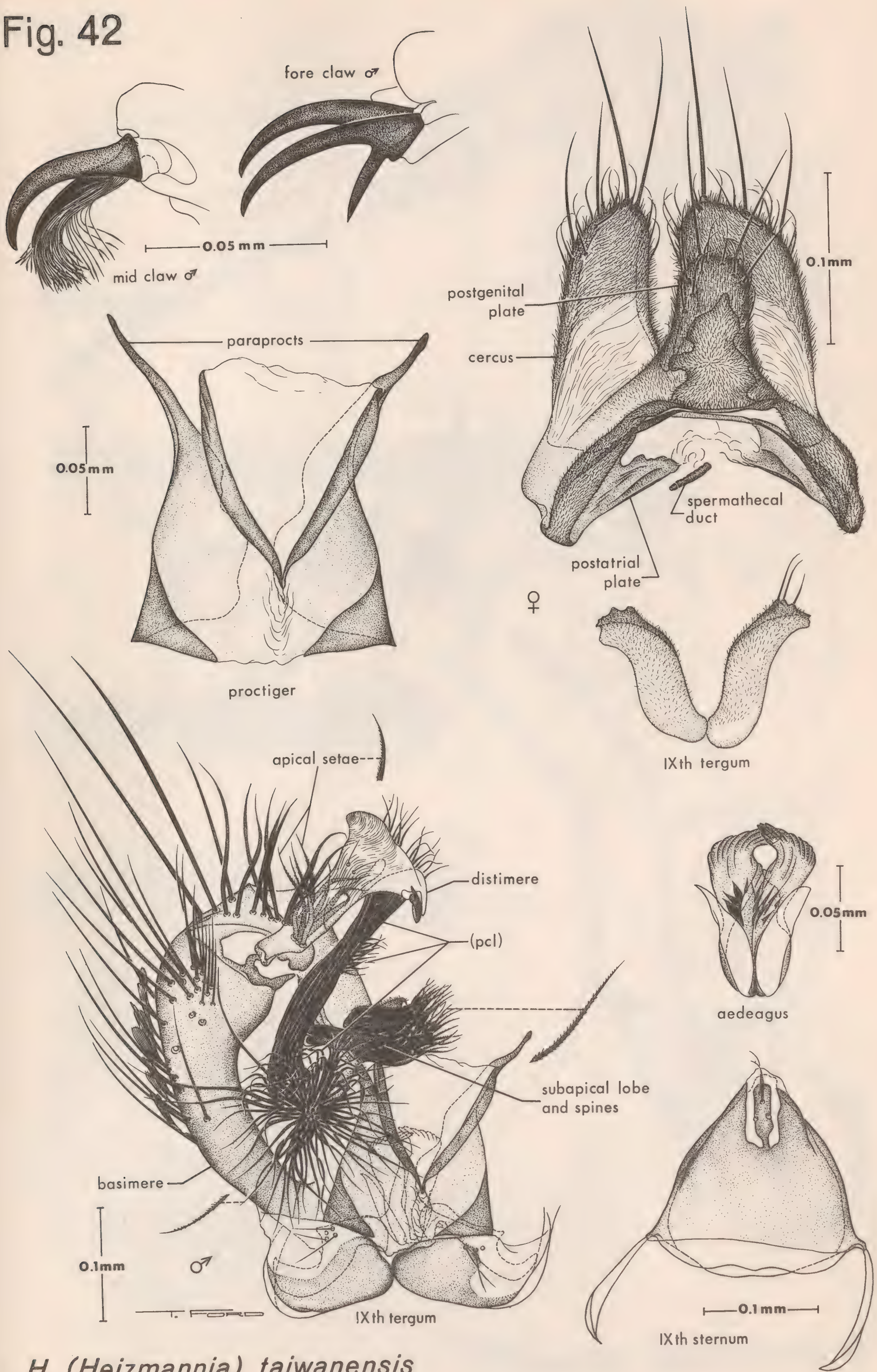


H. (Heizmannia) scintillans



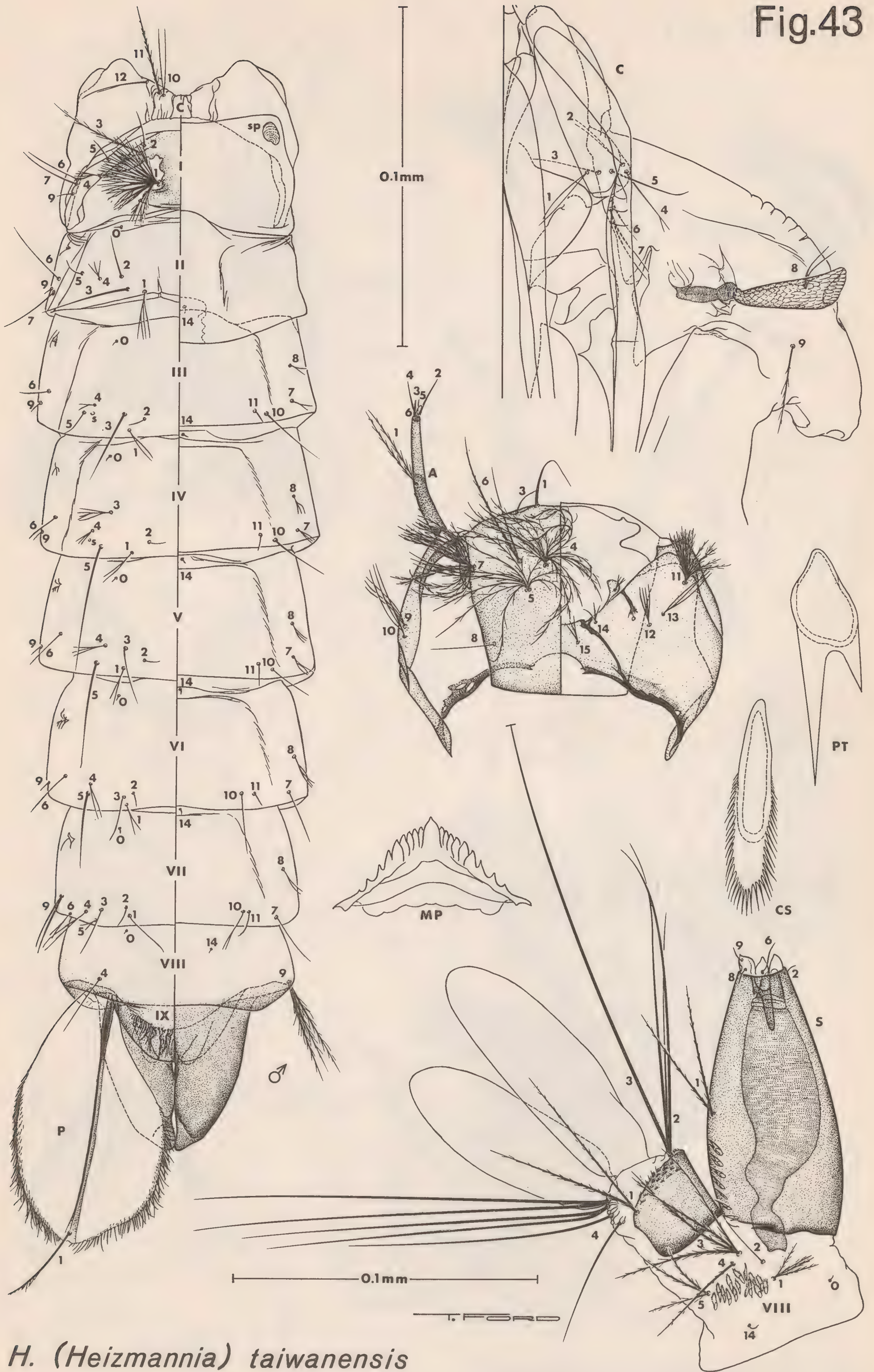
H. (Heizmannia) scintillans

Fig. 42



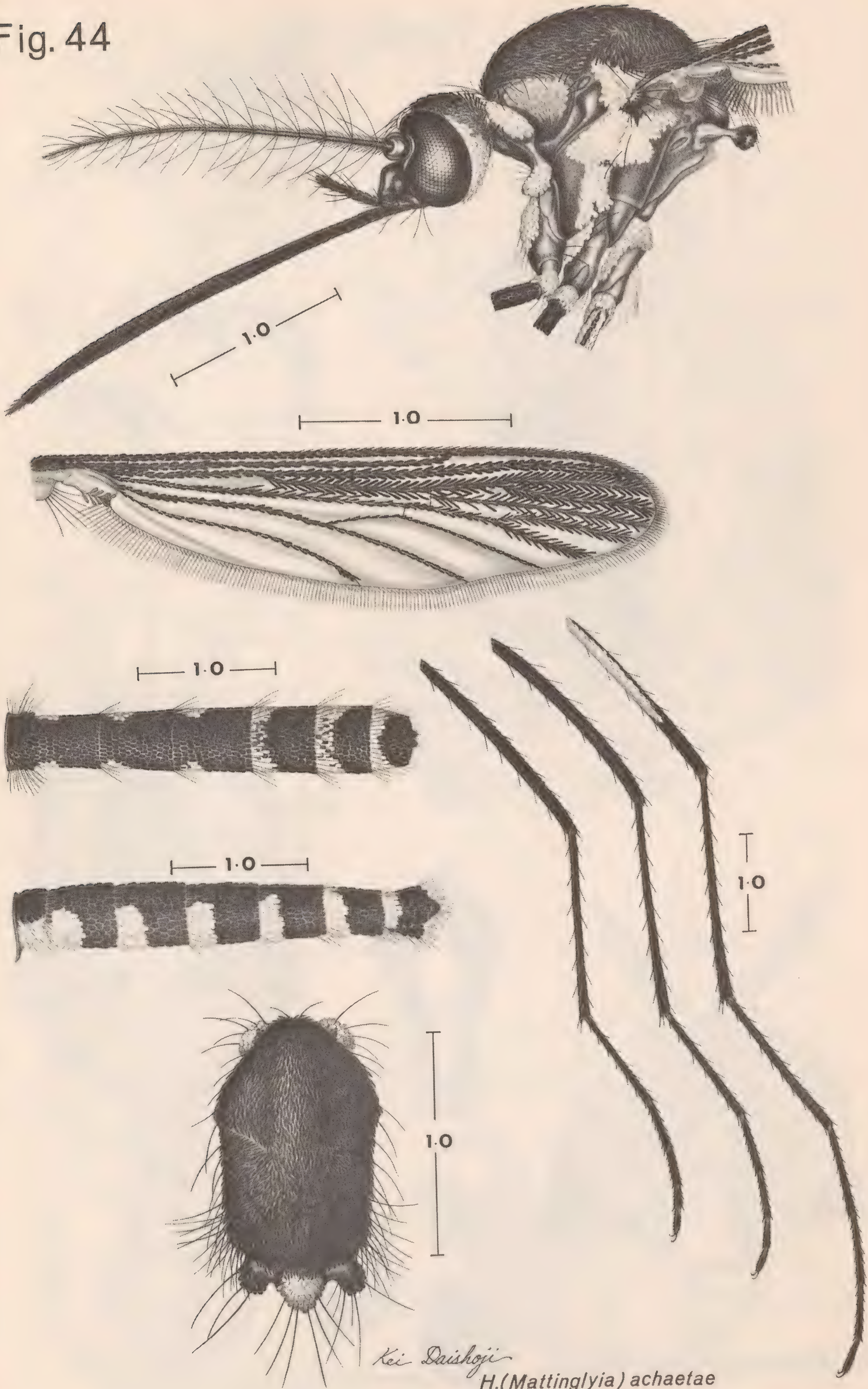
H. (Heizmannia) taiwanensis

Fig.43



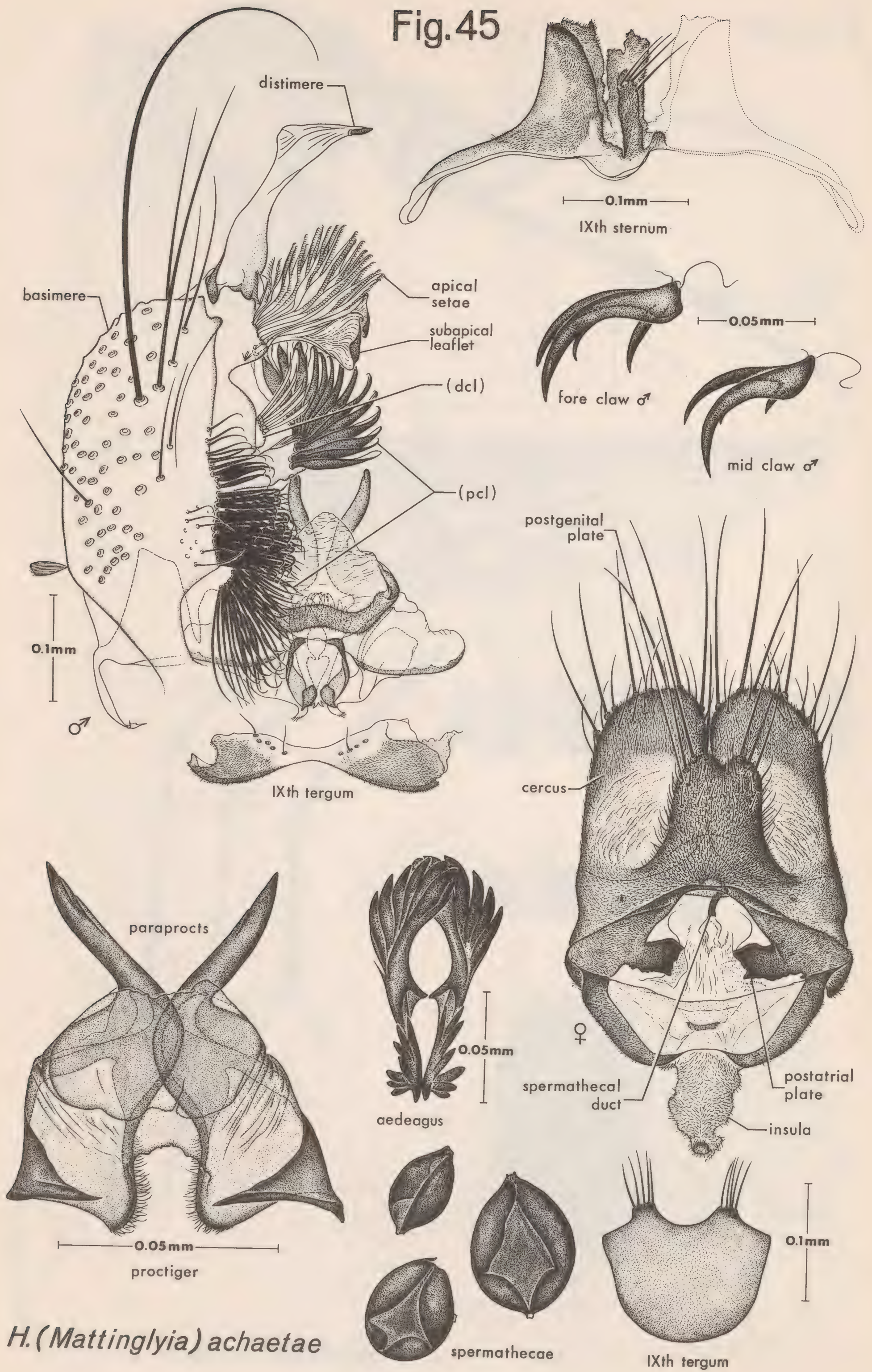
H. (Heizmannia) taiwanensis

Fig. 44



H.(Mattinglyia) achaetae

Fig.45



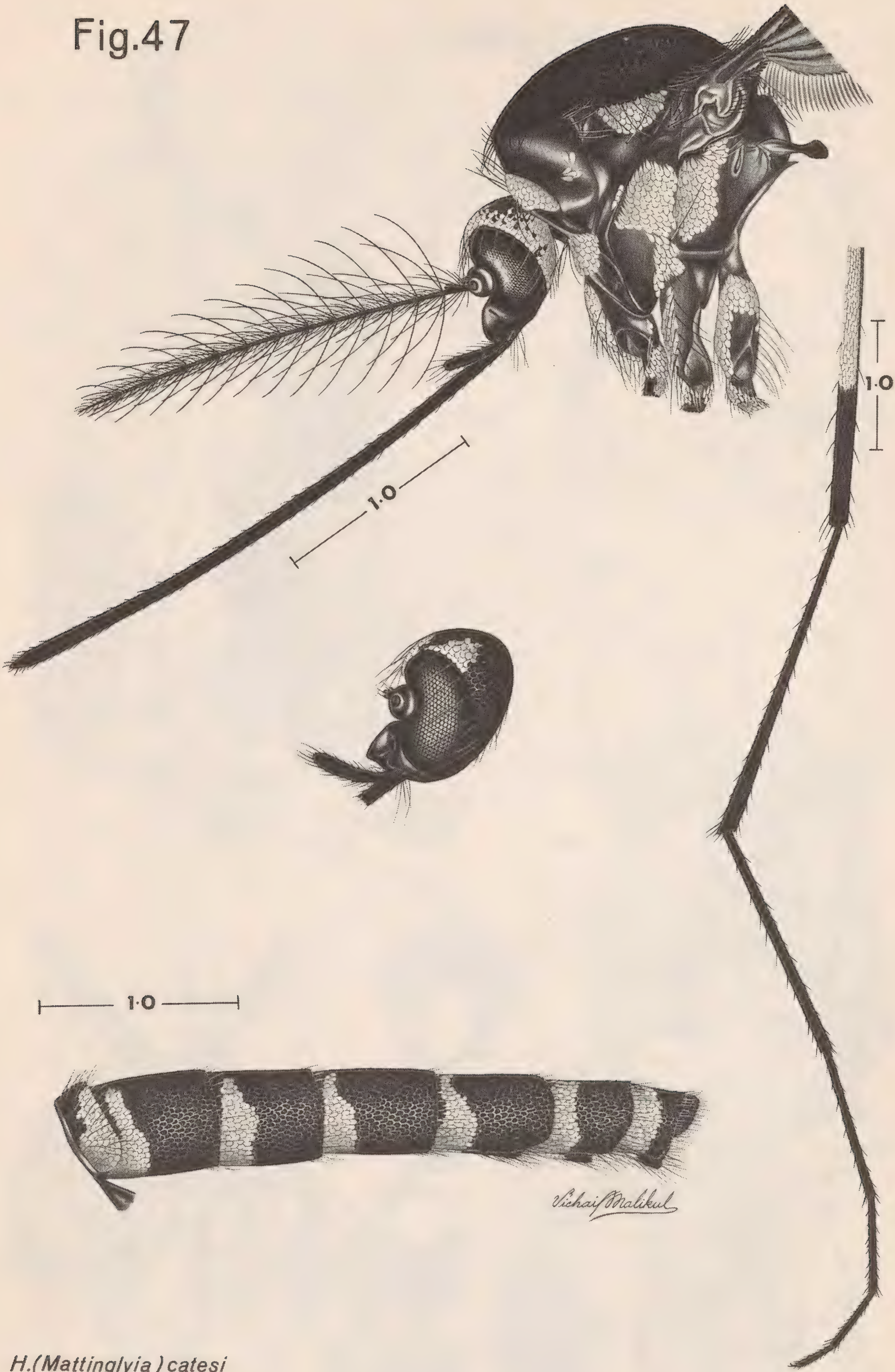
H. (Mattinglyia) achaetae

Fig. 46



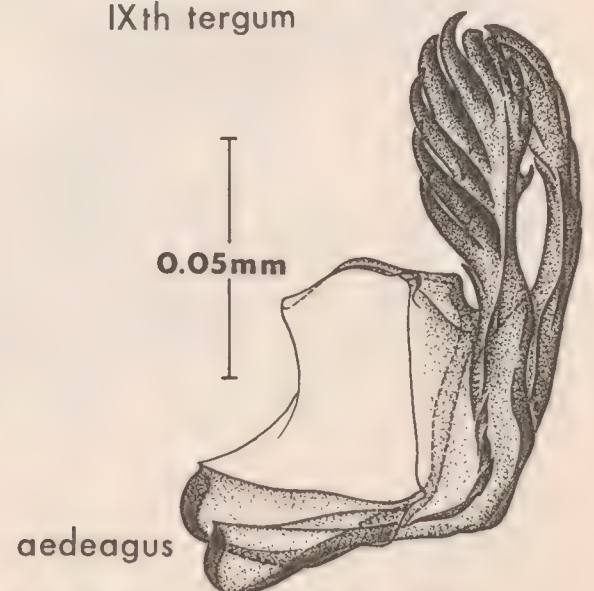
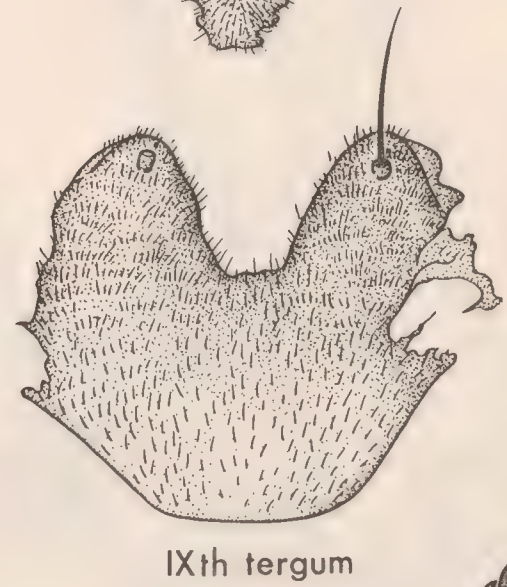
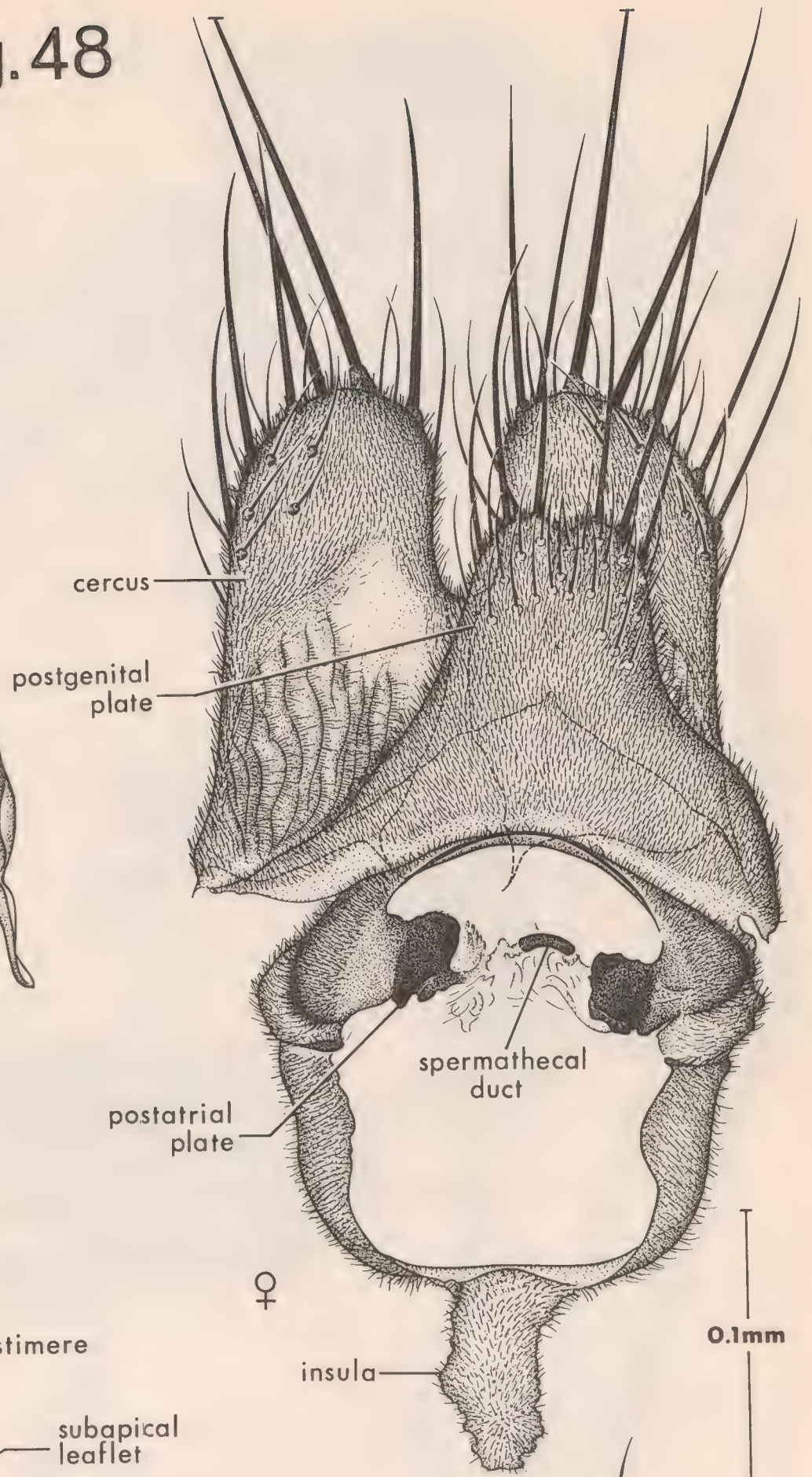
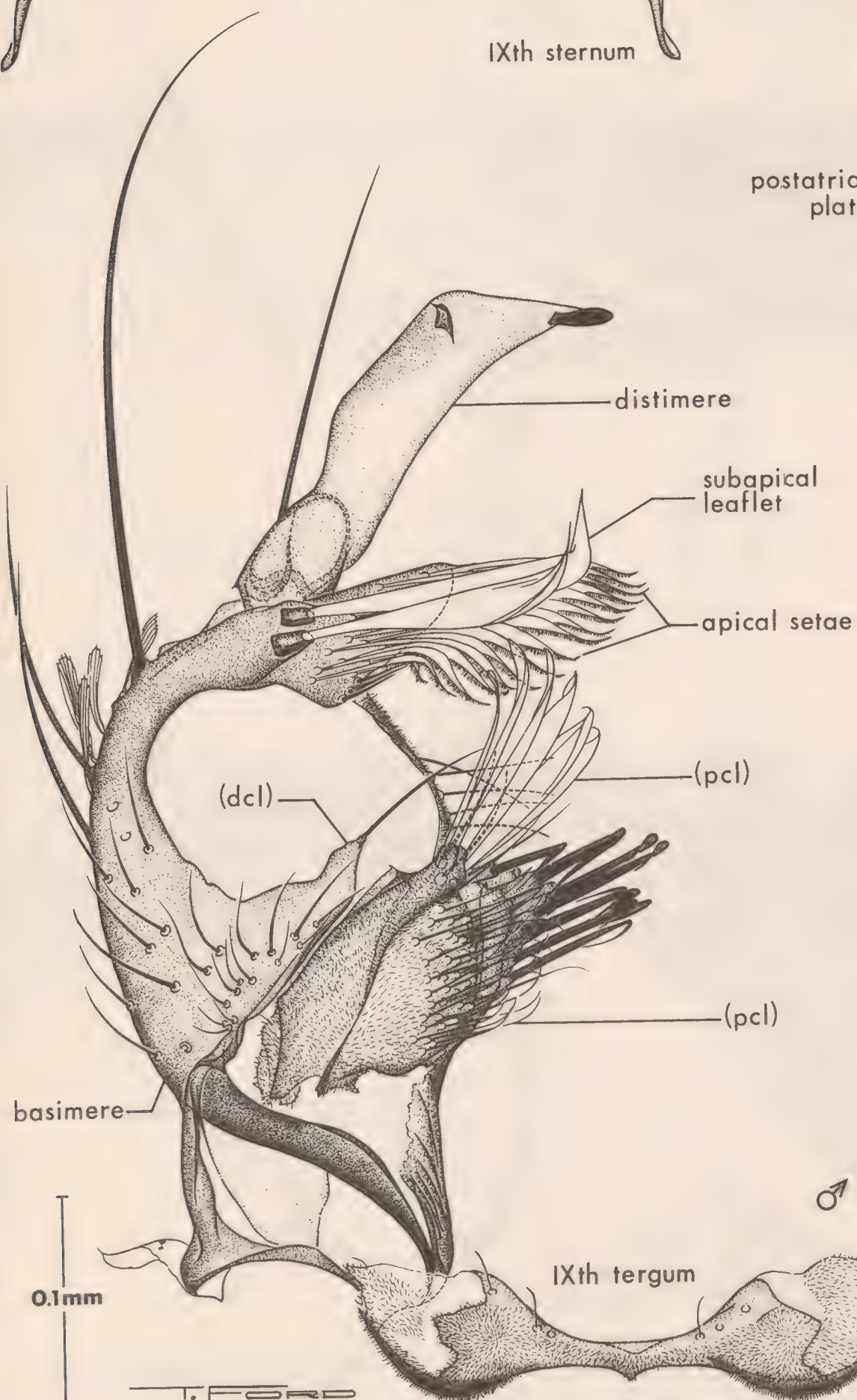
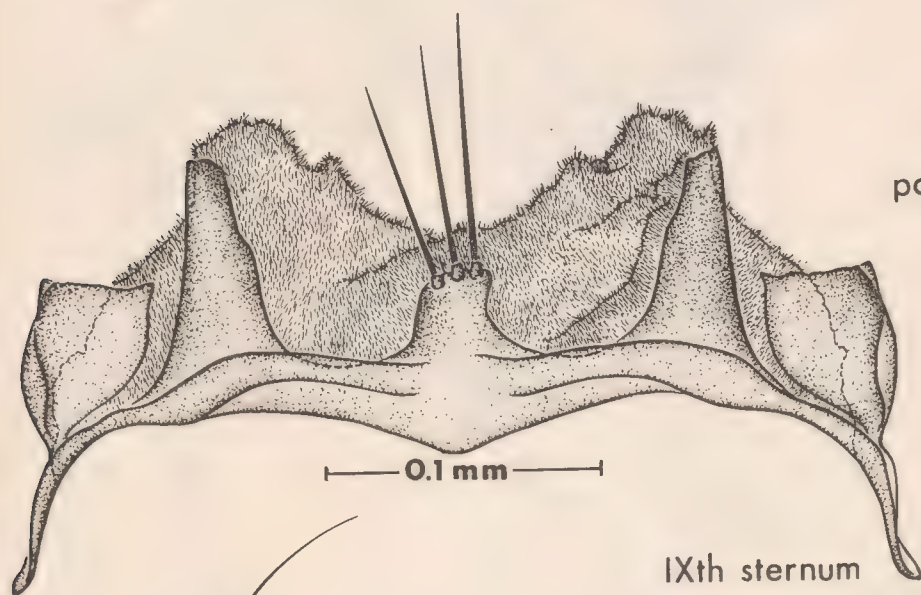
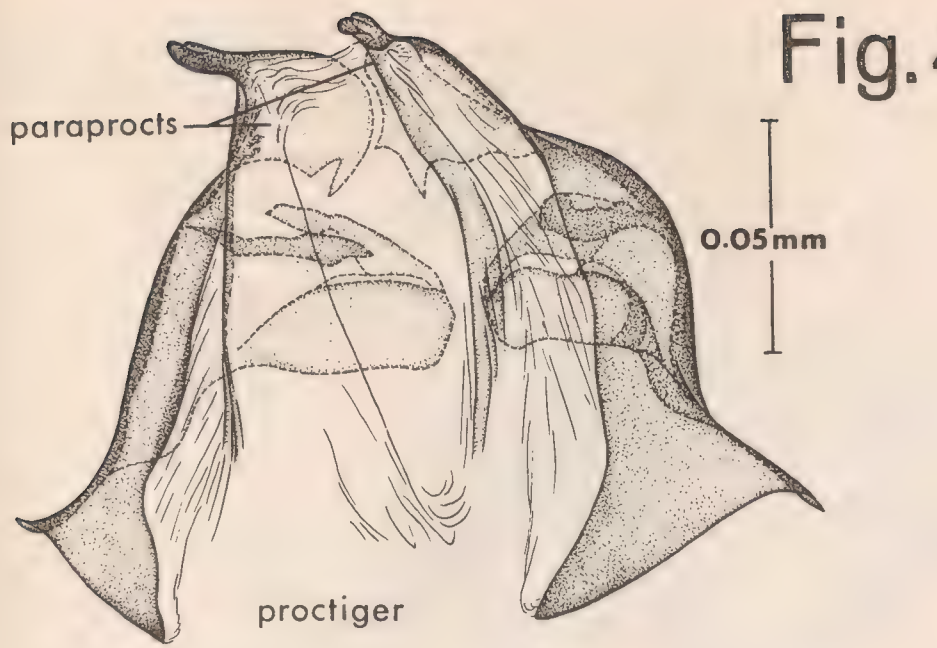
H. (Mattinglyia) achaetae

Fig.47



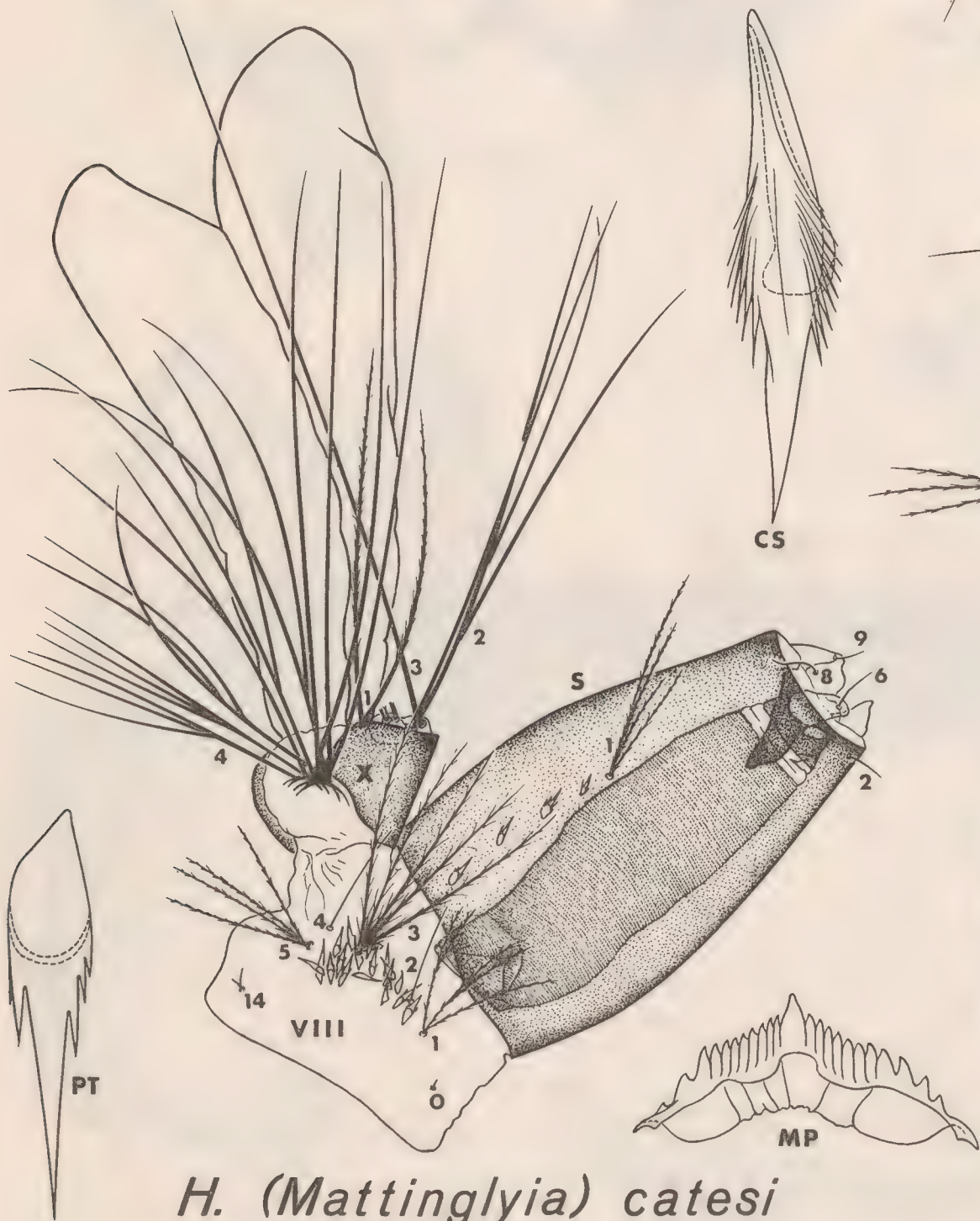
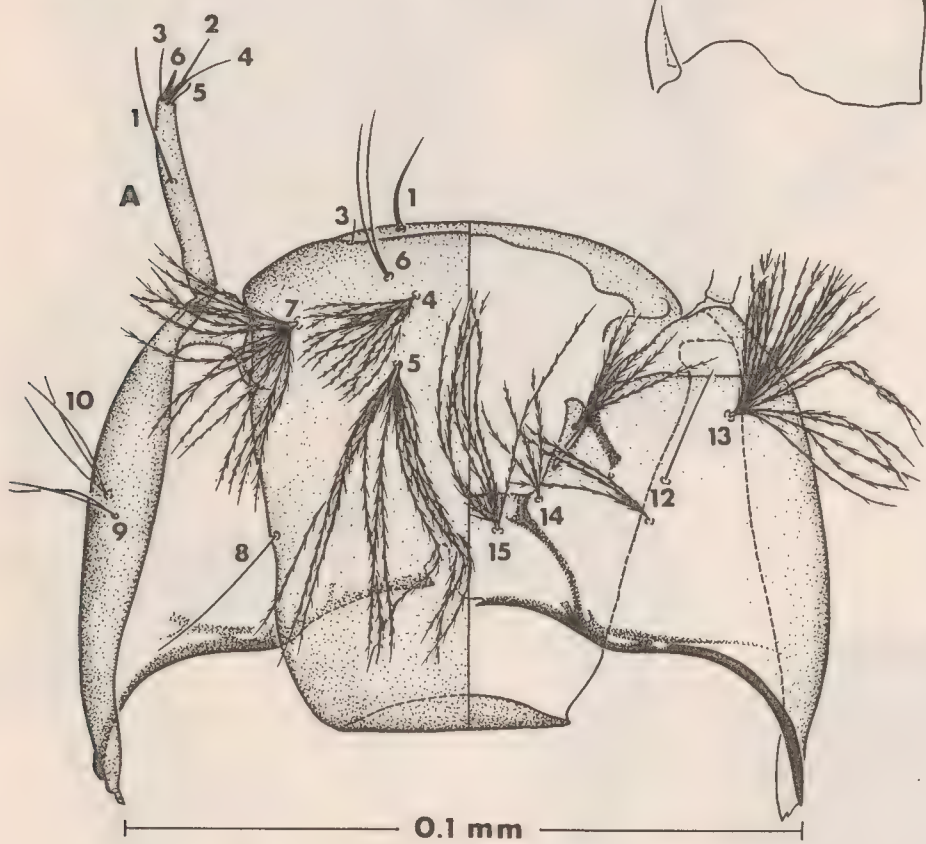
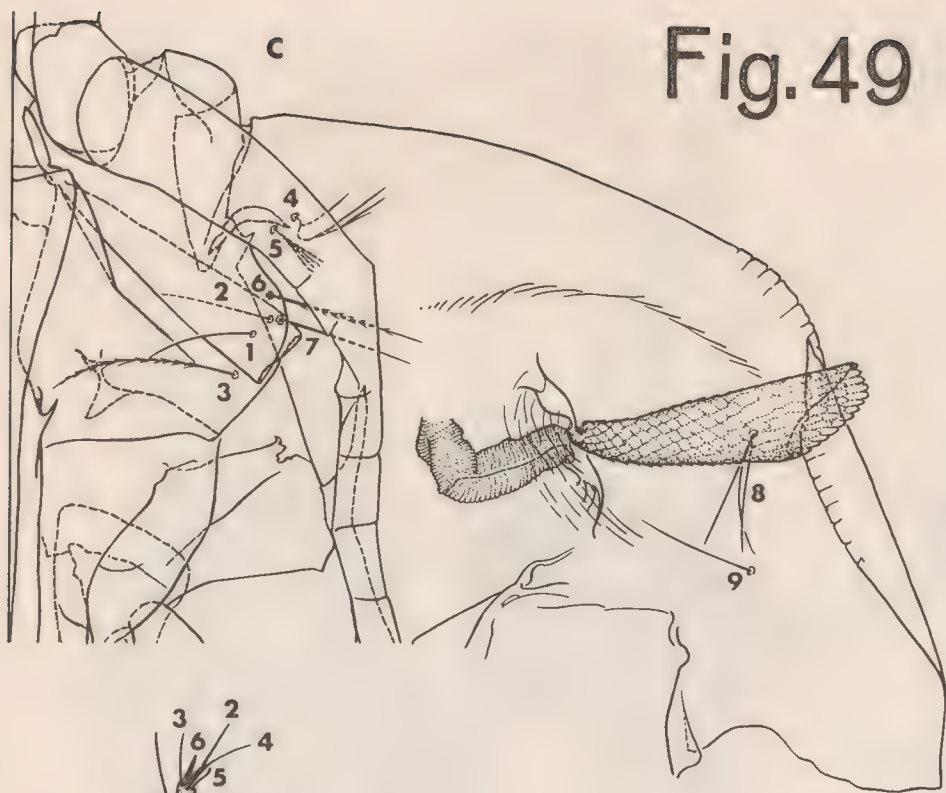
H.(Mattinglyia) catesi

Fig.48

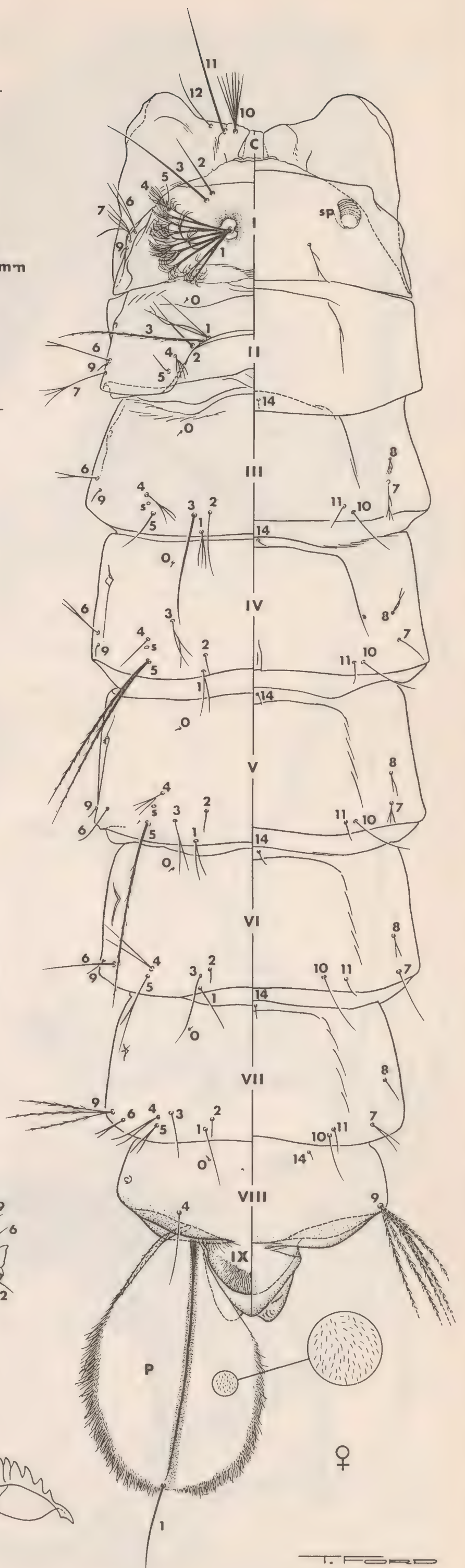


H. (Mattinglyia) catesi

Fig.49

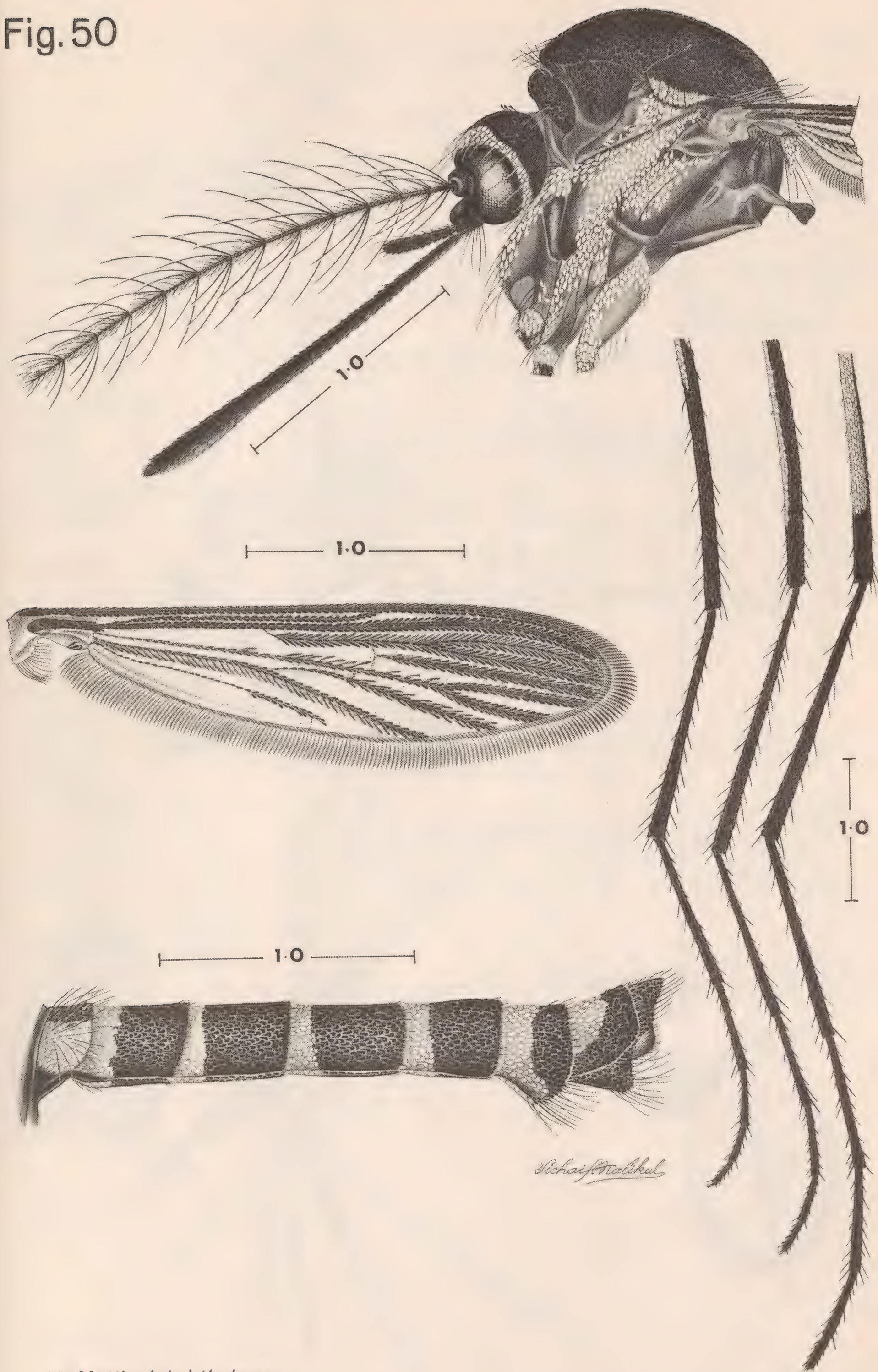


H. (Mattinglyia) catesi



T. FORD

Fig. 50



H. (Mattinglyia) thelmae

Fig.51



H. (Mattinglyia) thelmae

INDEX

Valid names are set in roman type, synonyms are italicized. The italicized pages are those which begin the primary treatment of the taxon. Numbers in parenthesis refer to the figures illustrating the species in question.

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anopheloides	15.
aureochaeta	4, 5, 7, 8, 9, 11, 15, 18, 38 (2, 3, 4).
bambusa	15.
<i>Bolbodeomyia</i>	2, 11, 17.
catesi	2, 6, 7, 9, 43, 44, 46, 48, 49 (47, 48, 49).
chengi	5, 6, 8, 10, 13, 17, 26, 30 (5, 6, 7).
<i>cheni</i>	1, 35, 37.
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Publication dates for Volume 4 of
Contributions of American Entomological Institute

Volume 4, no. 1	Nov. 8, 1968
no. 2	March 13, 1969
no. 3	July 12, 1969
no. 4	May 16, 1969
no. 5	May 5, 1970